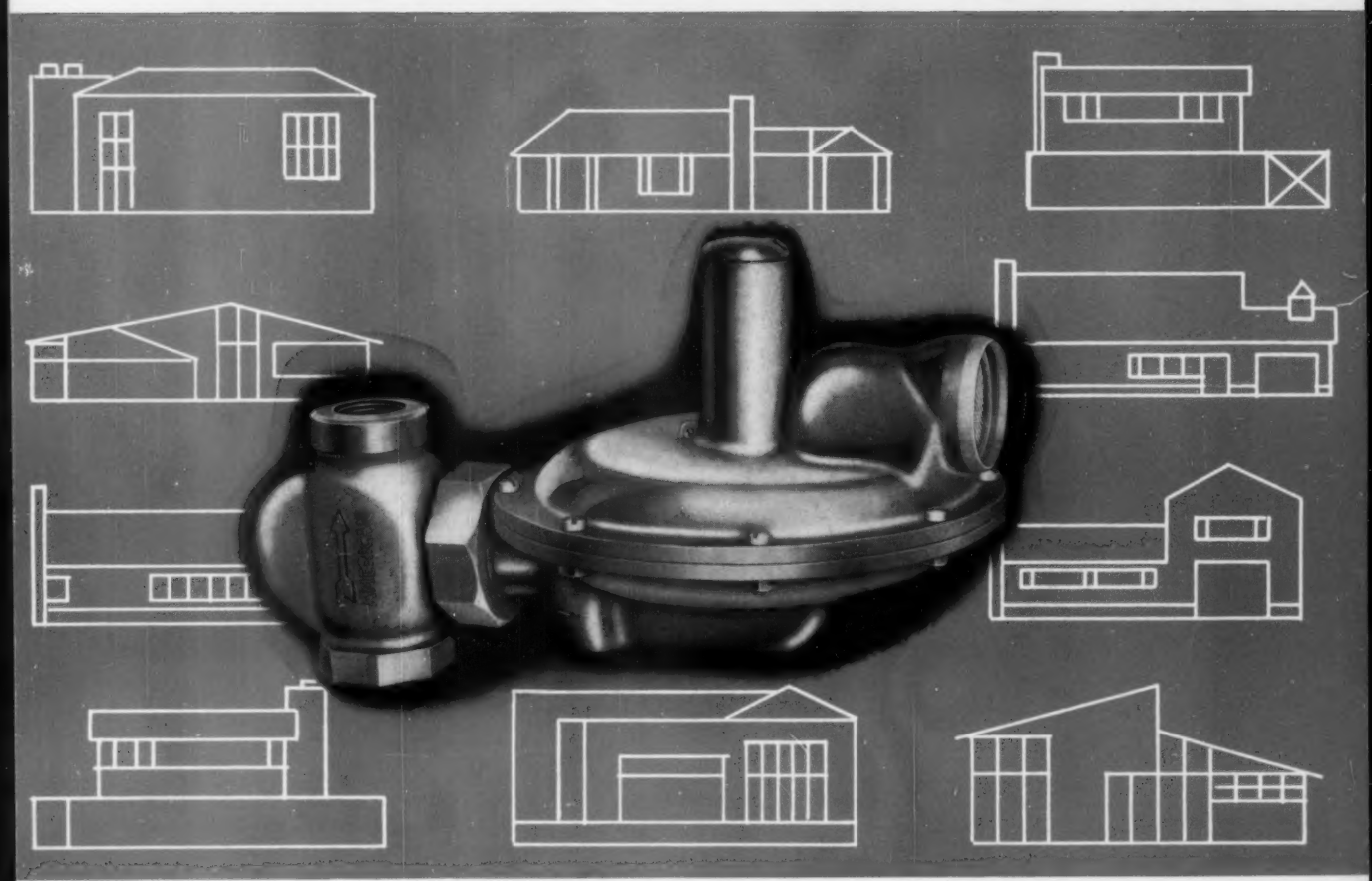
GAS

SEPTEMBER 1960

Orifice meter installations

A CHILTON PUBLICATION

THE NATION'S NATURAL GAS AUTHORITY



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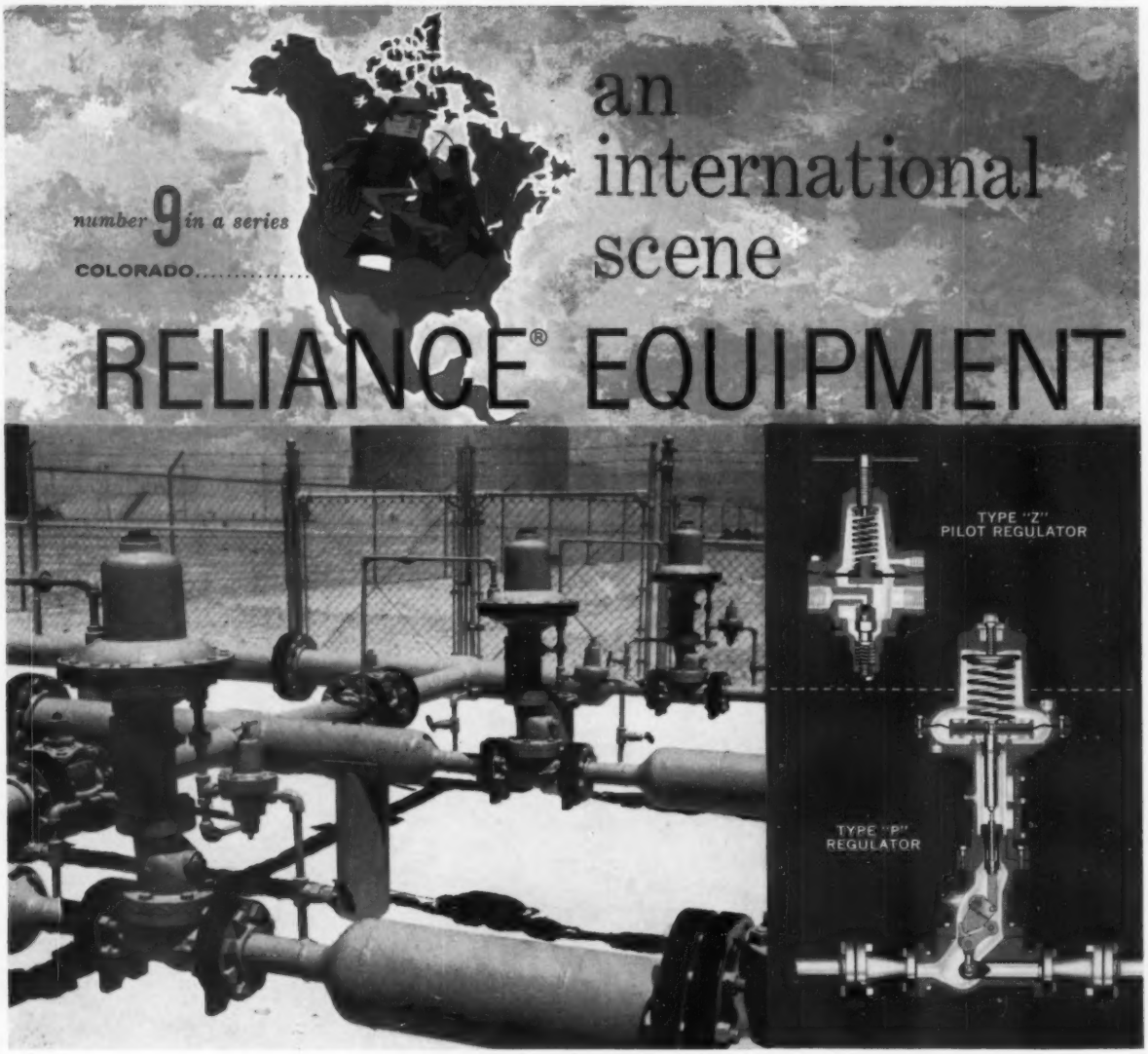

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GAS

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36TH YEAR OF PUBLICATION VOLUME THIRTY-SIX · NUMBER 9

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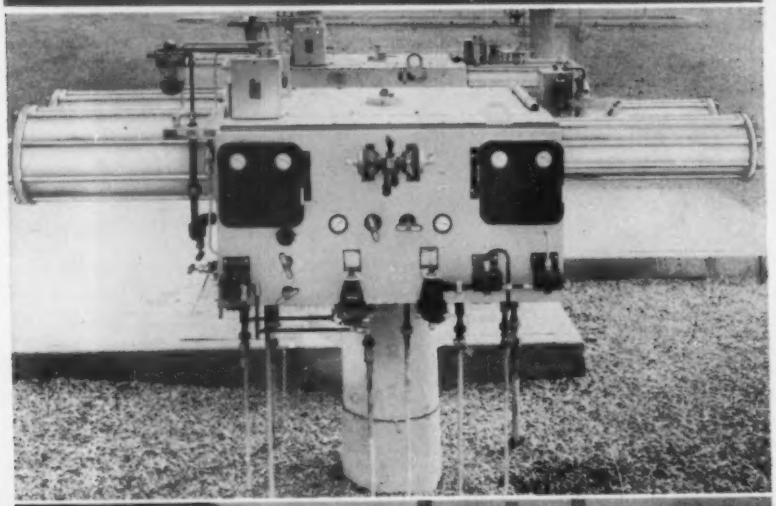

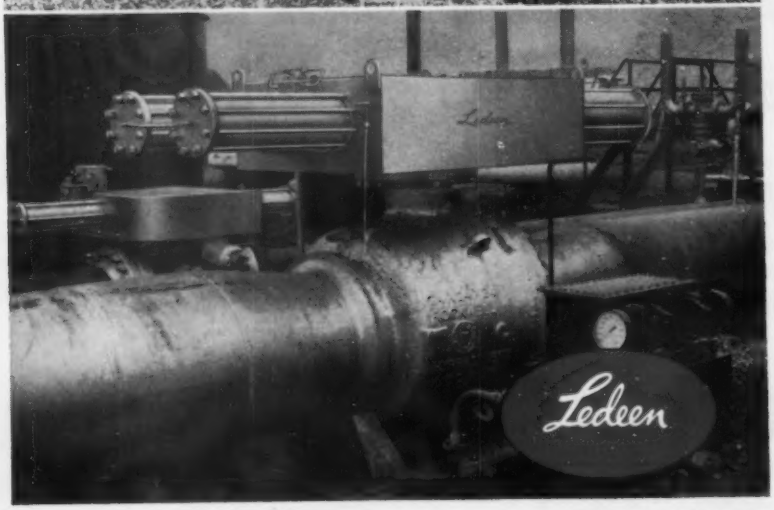

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CALENDAR

September

12-13..NEGA Gas Utility Managers Conference — Wianno Club, Mass.

12-14..AGA Accident Prevention Conference—Leamington Hotel, Minneapolis.

21-23..Southeastern Gas Association Annual Meeting — Sir Walter Hotel, Raleigh, N. C.

21-23..PCGA Annual Convention — Westward Ho Hotel, Phoenix, Ariz.

22..NEGA Safety Conference—Statler Hotel, Boston

27-29..Mid-west Gas Association Gas School and Conference—Iowa State College, Ames.

October

4-5..Gas Measurement Institute — National Guard Armory, Liberal, Kan.

5-7..Wisconsin Utilities Association Gas, Electric, Sales & Engineering Convention—Schroeder Hotel, Milwaukee.

9-12..AGA Annual Convention—Atlantic City, N. J.

17-21..National Safety Council Annual Meeting—Chicago.

23-25..Independent Petroleum Association of America Annual Meeting —Statler Hilton, Dallas.

November

1..NEGA Operating Division—Statler Hilton, Hartford, Conn.

14-16..American Petroleum Institute Annual Meeting—Chicago.

15-16..Natural Gas Pipeline Institute—Court Room, Court House, Liberal, Kan.

1961

March

13-17..National Association of Corrosion Engineers Annual Meeting Hotel Statler, Buffalo.

15-17..New England Gas Association Annual Meeting—Hotel Statler, Boston.

20-22..AGA General Management Section Conference—Frances-Marion Hotel, Charleston, S. C.

27-29..Mid-West Gas Association Annual Meeting — Sheraton-Fontenelle Hotel, Omaha.

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GAS

SEPTEMBER 1960

Thermally Thinking

Wanted: New faces for a new adventure

A DYNAMIC industry which is on the move generally embarks upon new adventures rather brashly. It is left to later historians from Homer to Kiplinger to fill in all the reasons.

Motives for new adventures are many, but one of the strongest is almost always the same: The demonstration of a successful industry.

Our industry—the gas industry—will create the most important demonstration of itself in Atlantic City starting Oct. 9. While this industry is enmeshed in the most trying net of regulatory chaos, economic pressures, and lack of unified leadership in its history, it will bring forth the largest demonstration of its success and confidence in its ability to rack up future successes. It is a brash move. It is also a logical move for a gas industry that will not stand still.

The mentioned event is a "Festival of Flame" which will be the major feature of the 1960 AGA Convention.

Festival of Flame will not be a hall full of last year's appliances strewn about with colorful backdrops, complete with a gully-mouthed sales type and "Miss Flame Propagation of 1960" poured into (almost), and shimmed up by, a gold lamé bathing suit. It will be a working demonstration of the gas industry from exploration to utilization. I am told it will forget the past and present the future. Certainly it is a new adventure in convention planning. Never before have we had demonstrations of drilling rigs, communications, remote control, and other operating tools on AGA's exhibit floor along with promotion plans, sales, research and, thank goodness, end-use gas appliances and equipment.

Newness is the key. Here's a "show" where people can see what is coming up in nearly every segment of the many operations that make a gas industry. And coupled with this Festival of Flame is a team of outstanding speakers to tell what lies ahead for the gas industry in the Sixties.

Speaking directly to gas company management, I will ask: Who are you going to send to this adventure? I hope it will be those people who will be top management and department heads in your company five, 10, and 15 years from now.

Current executives, the more matured department heads, and those looking forward to retirement in just a few years have had their chance to do something to or for the industry. It will not hurt some of them to stay in the shop during an AGA Convention because it is very likely they have been to plenty of them in the past.

Also, leave home the semi-professional socializers, back thumpers, glad-handers, and the scotch and bacon-wrapped chicken liver crew. Their basic objective is merely furthering their own careers. They'll be so busy socializing that they won't be able to focus on the exhibits, won't hear a single address, and won't be worth a nickel to the company for three days after they get back from Atlantic City anyway.

Look down into the middle management group. You have some eager juniors in the engineering, operating, sales, utilization, appliance servicing, and other departments who will take in the convention and Festival of Flame and come back with some hard-nosed, money-making, business ideas.

Get some new faces in the act. Get those faces into the act right now that we will be looking up to in 1970 for leadership in this gas industry.

Send all the people you can afford to send. Then, send even more. Can you think of a better investment than letting many key people in your company's future take a look at this gas industry's future and the tools and appliances that will take it up that path of progress?

Lastly, dear management, send these people to the Festival of Flame orientated and imbued with the need to make this convention a period of work and serious concentration. Send them fired up with a quest for knowledge. Send them with the idea in mind that they are in Atlantic City to gain ideas, skills and answers; and, after the obtaining, to bring them back and put them to work in your company.

Over 100 years ago, Michael Faraday told a government committee that he didn't know of what practical benefits they could expect from his electromagnetic equipment, but that ". . . 100 years from now you will be taxing this." If you send the right personnel to AGA's 1960 Convention and Festival of Flame, in less than five years your company will be profiting from this gas industry adventure.

J. Fred Ebsen

EDITOR

When you install services -use a REAL saddle!

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GAS HIGHLIGHTS

Industry zings in '60

AGA points out that the biggest construction push in history of gas utility and pipeline companies is shaping up. In late July, AGA saw a $2.233 billion construction year for '60. GAS' crystal ballers pegged it at $2.200 billion in late February.

Strike hits East Ohio

In early August, the Natural Gas Workers Union struck the East Ohio Gas Co. Company had offered a two-year contract with wage increases of 4 per cent (10 cents per hour) each year. Union struck for a one-year contract and more increase in employees' salaries.

FPC sets Transwestern price

Transwestern wanted 43 cents per Mcf at the California border; Pacific Lighting companies urged a 42.25-cent-per-Mcf price; FPC set it at 42 cents. With that action on Aug. 5, Transwestern's gas moved into the Los Angeles basin on Aug. 9.

Alaska to be 47th natural gas state

Construction has started on Alaska's first natural gas system. Crews are laying 8-in. main for a distribution system in Anchorage for the Anchorage Natural Gas Corp. Thus, Alaska will become the 47th state to enjoy some natural gas service. An 80-mile pipeline is also under construction. It will bring gas from the Kenai peninsula fields to the new utility. Other areas will be served in the future.

Gas usage up

AGA reports for the 12 months ending May 31 that natural gas sales are up 8.0 per cent; manufactured gas sales are down 5.2 per cent; total gas sales are up 7.7 per cent.

Gas A/C doing well in Chicago

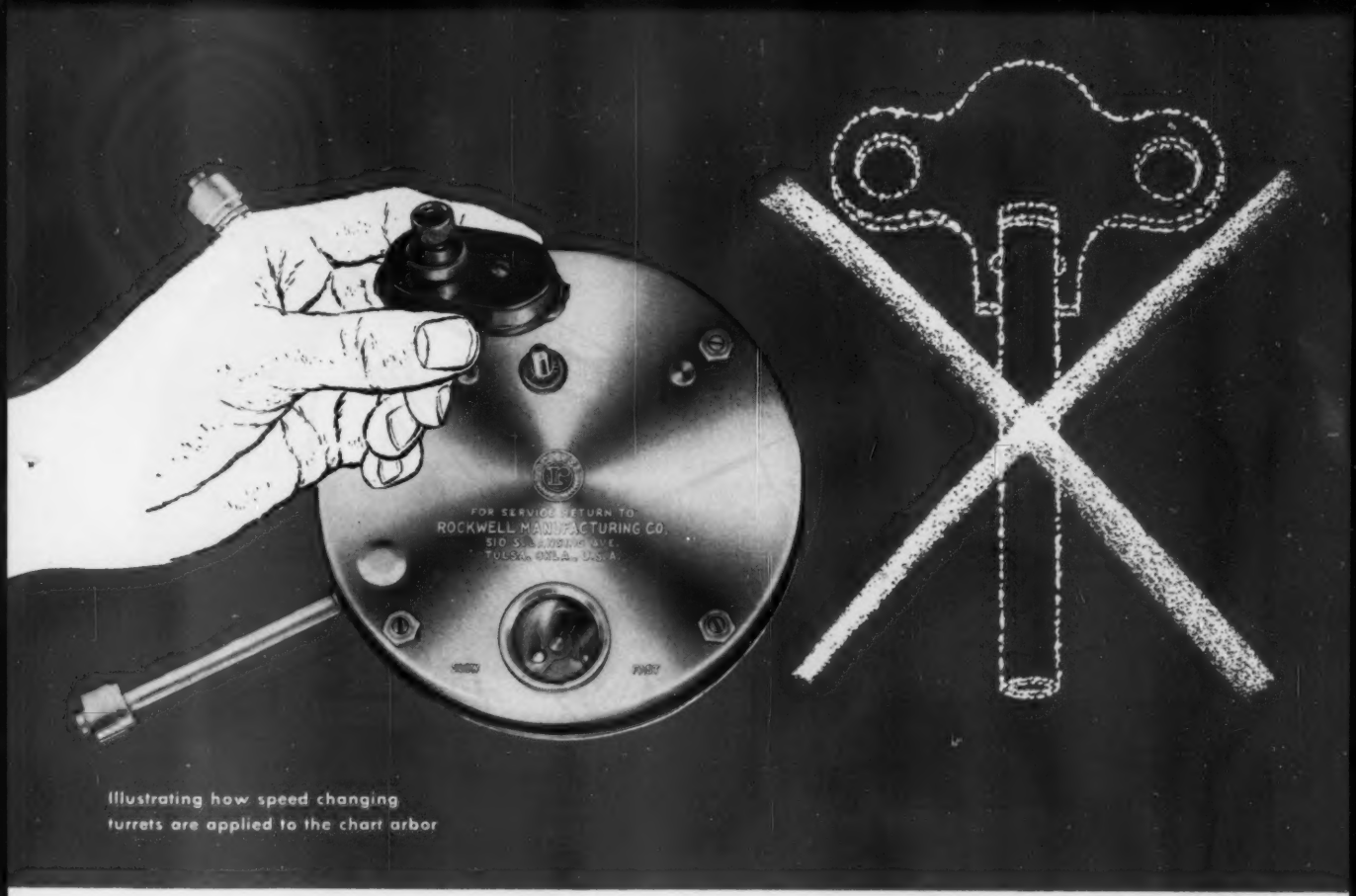
Some 40 large commercial and industrial buildings, and over 500 residential and smaller commercial and industrial establishments in Chicago are utilizing one or more of the three basic gas air conditioning systems. Stimulus for this success: a stemwinding advertising-promotion program by Peoples Gas Light & Coke Co. A 49-page "Guide to Gas Air Conditioning," designed for architects and engineers is a key part of this campaign. Many more customers have been sold, but are awaiting delivery of equipment.

FPC finally okays more Canadian gas imports

FPC authorized more than 500 MMcfd of Canadian gas to flow into the Pacific Northwest and California. Pacific Gas Transmission Co. (a subsidiary of PG&E, San Francisco), El Paso Natural Gas Co., and Montana Power Co. will get the gas. The entire international project, including facilities to be built in California, will cost more than $400 million.

Appliances going, says GAMA

While manufacturers appraised the gas appliance market as anywhere between "soft" and "flat mushy," GAMA had these encouraging reports: Gas built-in ranges soared higher than in any previous month. Factory shipment of the built-ins was 13.4 per cent more in June than the former record of 37,200 units marked up in the same month of '59. Free-standing gas ranges trailed a bit in June but still hit 125,000 units for the month and 753,700 for the six-month period. Then, the 256,200 automatic gas-fired water heaters shipped in June beat any previous June, while first six months' shipments of gas conversion burners and boilers for residential service streaked away from year-ago levels by 14.6 and 7.9 per cent, respectively. But, the "downs," said GAMA's Ed Martin, included gas furnaces, vented recessed wall heaters, room heaters and direct heating equipment, gas floor furnaces, and unit heaters and duct furnaces.



Illustrating how speed changing turrets are applied to the chart arbor

You never need to wind the Rockwell Gas Drive

GAS (OR AIR) POWERS THIS NEW CHART TIMING DRIVE. With it you can forget the costly chore of periodic winding. It's completely self-starting, self-contained. You can use the Rockwell Gas Drive with profit and gain accurate, automatic operation of recording charts on practically any make orifice meter, gas lift intermitter, pressure recorder or temperature gauge. It is particularly applicable for remotely located instruments.

Since the Rockwell Gas Drive consumes only 6 cubic feet of gas in 24 hours it is economical to use—safe, too, for there is no exhaust problem.

The Gas Drive operates on a pressure range of 15-25 psi and delivers 15 in. lbs. of torque to the main arbor which rotates once every 24 hours. Geared turrets which snap onto this arbor provide optional speeds of 2, 3, 4, 6, 12, 48 or 72 hour, 7 or 8 day rotation. So with a stock of Rockwell Gas Drives, plus a selection of economical turrets, you can serve all your instrument needs. Get facts now. Write Rockwell Manufacturing Company, Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Guelph, Ontario.

◀ Rockwell Gas Drive powers this typical intermitter

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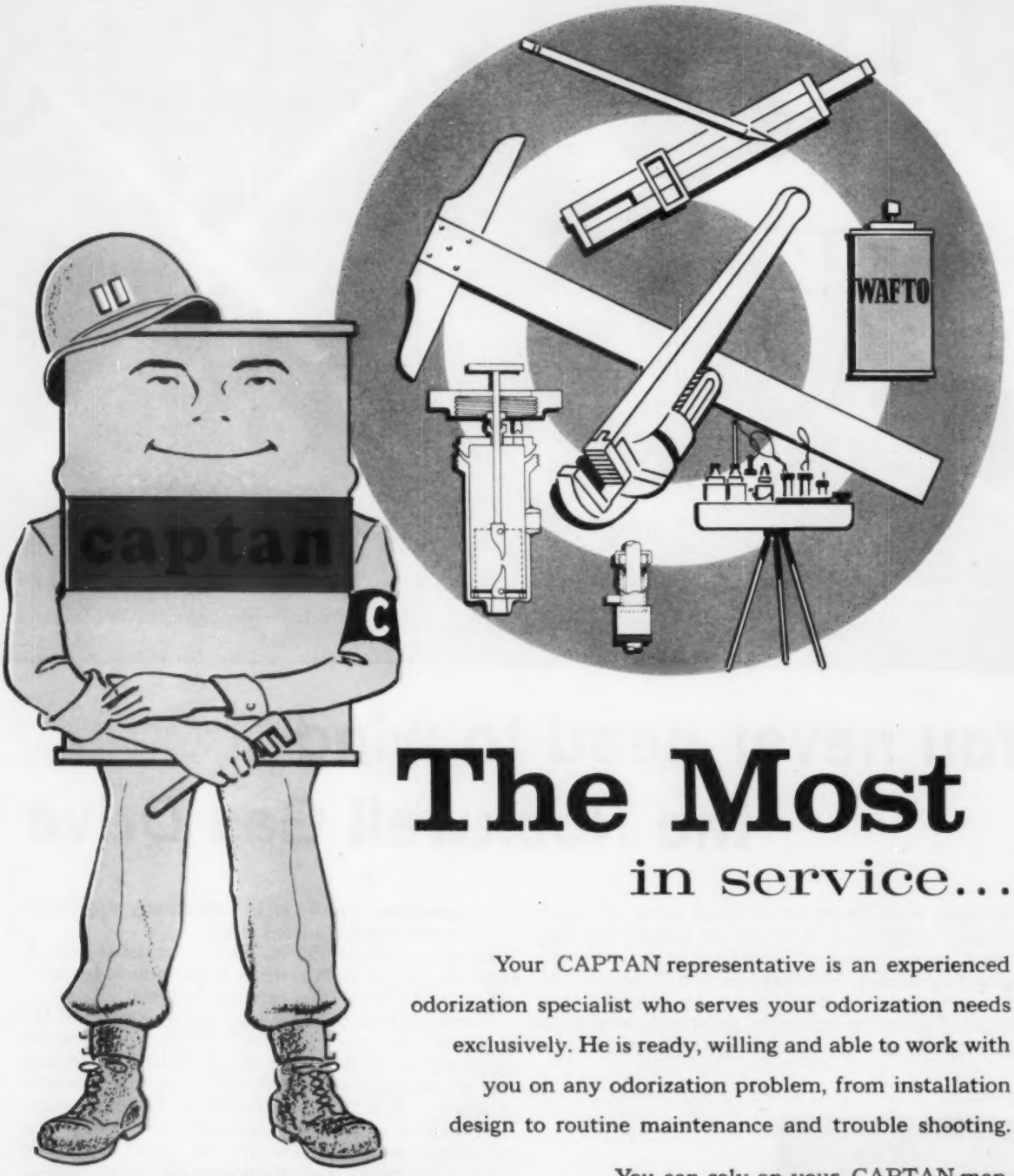

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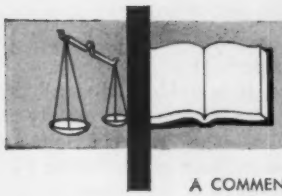


Regulatory and Legislative Trends

A COMMENTARY ON NATIONAL AND STATE DEVELOPMENTS BY AN EXPERT IN UTILITY LAW

Sell gas and you are bound

SELL natural gas in interstate commerce for resale and you are obligated to continue that gas service beyond the term of your contract. To discontinue gas service you must obtain FPC permission. FPC can grant abandonment of gas service only after a finding that the available supply of natural gas is depleted to the extent that continuance of service is unwarranted. Or that the public convenience and necessity permit it.

That service obligation was placed in the national spotlight by a recent United States Supreme Court decision involving a natural gas producer. An independent producer contracted to sell natural gas for 20 years to an interstate gas pipeline company. The initial price was 20.5 cents per Mcf and the price was to increase 1-cent per Mcf every five years. The gas producer applied to FPC for a certificate authorizing the sale. The commission rejected the producer's request for a 20-year certificate and permission to stop gas deliveries at that time. FPC offered the producer a certificate without a time limitation. The producer did not exercise the right to refuse the FPC certificate. Instead the producer accepted the commission's unlimited certificate and started deliveries of gas, while reserving its right to object in a court review. The United States Supreme Court affirmed a lower court, and ruled that FPC has authority to offer a certificate without time limitation. This is an important decision for management to remember.

• The Supreme Court's reasons

The Supreme Court referred to the obligation under the Natural Gas Act to continue service unless FPC makes the pre-requisite findings of a depleted natural gas supply or public convenience to permit abandonment. The Court stated:

"If petitioner's contentions, as to the want of authority in the commission to grant a permanent certificate where one of limited duration has been sought for, were to be sustained, the way would be clear for every independent producer of natural gas to seek certification only for the limited period of its initial contract with the transmission company, and thus automatically be free at a future date, untrammeled by commission regulation, to reassess whether it desired to continue serving the interstate market. And contracts * * * might provide for termination in the event of a rate reduction by the commission. Petitioner's theory, by tying the term of the certificate to the contract, would mean that such a reduction of rates would under those circumstances enable the producer to cease supplying gas, without obligation to justify its cessation of this service as being consistent with the public convenience and necessity.

"The consequences of petitioner's argument do not stop there. The identical provisions of the Natural Gas Act regulate pipeline companies as well as independent producers. If producers can insist in their certificates on the inclusion of a provision relieving them in advance from their obligation to continue the supply of gas, as of a date certain, pipeline companies—whose dealings with local distributing companies generally also take the form of a 'sale' of gas to them—could insist on a similar provision. If an individual producer were thus left free to discontinue his supply, the transmission company would be forced to find a supplier of gas elsewhere, and make connection with him, to continue its service; and the consumer ultimately would pay the bill for the rearrangement. If the pipeline company were left free to cease its service to the local distribution company, a local economy which had grown dependent on natural gas as a fuel would be at its mercy."

The Natural Gas Act was passed in view of the problem of the great economic power of the interstate gas pipeline companies as compared with that of communities seeking natural gas service.

• Impact on rates

There are practical consequences, related to rate control, which are even more concrete. If the producer's certificate of public convenience must expire with its first contract with the pipeline, service after then—under a new contract or otherwise—will require a new certificate. And under that certificate, the producer may file, pursuant to §4(c) of the Act, its rates for the "new" service. The only power the commission would have, with respect to those rates, would be to bear the burden of proof in an investigation under §5 of the Act, that the rates are unreasonable, and then order a new rate for the future. In the Catco case the Court stated: "the delay incident to determination in §5 proceedings through which initial certificated rates are reviewable appears nigh interminable." No contested major producer's §5 case has been finally adjudicated by the commission in the six years since the decision in the *Phillips* case. In contrast to §5 are the protections that would be available if at the conclusion of the original contract

the producer's certificate remained in effect. Then the rates to be charged under a new contract would have to be filed as rate changes under §4(d) of the Act. Under that Section, the commission may order a hearing on the new rate, and suspend the effectiveness of the rate for five months. At the hearing, the gas company would have to prove that its new rates were just. If the hearing were not concluded by the end of the suspension period, the increased rate could be collected, subject to refund if it could not make out its case for the increase.

The Supreme Court was displeased with the results on rates of the producer's contention and declared: "When attached to the leverage of a power to abandon service, at a contract's termination, without contemporaneous commission approval, this power to exercise contractual control not only over rates but over the mode of their regulation, would be a substantial one indeed. And like the power to force an advance license for the abandonment of the continued supply of gas, the power would be one enjoyed by pipeline companies and producers alike. Further, declaration today of a want of authority in the commission to issue a certificate of longer duration than that of a sales contract attached to the application would have a retroactive effect."

The Supreme Court found power in the commission to protect the public interest in certificate cases, and rejected the producer's claim to a certificate to serve gas for the period of the contract only.

• "Service" is broader than "sale" of gas

The gas producer claimed that the language of the Natural Gas Act confines FPC to authorizing or rejecting what the application proposes. The Court was not convinced, and said:

"The argument seems to us unpersuasive even on the face of the statutory language. It depends in the first instance upon freighting the phrase 'the whole or any part,' obviously intended to give the commission power to grant less than the whole of an application, with a load of negative meaning which nothing in the legislative history indicates that it was to bear. Even without the illumination of the purpose of the Act, it could be argued with equal force that all that was meant was that the certificate to be granted be one sufficient to authorize the specific 'sale' proposed; which an unlimited certificate clearly is, in any case."

The Supreme Court reasoned that the initial sale is the commencement of gas service, and that the language of the Act covering service included sales of gas. The Court asserted:

"Thus, it is evident that all the matters for which a certificate is required — the construction of facilities or their extension, as well as the making of jurisdictional sales—must be justified in terms of a 'service' to which they relate. Accordingly, §7(e) itself gives positive indication that the 'service' which the commission's certificate may authorize is something quite apart from simply the specific sales which §7(c) forbids without a certificate sufficient to authorize them. To be sure, §7(e) requires that the applicant be found willing to perform the 'service' in question; but surely such willingness can be inferred from its willingness to enter into a long-term sales contract. To say that the finding cannot be made in view of the applicant's declared desire to stop and have a look in 20 years as to its continued desire to be subject to regulation, and that this is a limit on its willingness to perform the service that the certificates must respect, is to make effective regulation turn on the desire of the regulated enterprise to be subject to it. The willingness to make the proposed 'sale' thus must imply willingness to perform the 'service' which it represents." ■

Ohio firm fights water heater enemy

McGeachie (left) and Baker (2nd from right) discuss the de-aerator with Perry E. Wacker (2nd from left), service manager at C. I. Baker Inc., and L. P. McIntire, Lorain (Ohio) manager for Ohio Fuel Gas Co. Natural gas is used as the fuel for most of the Baker water heating installations.

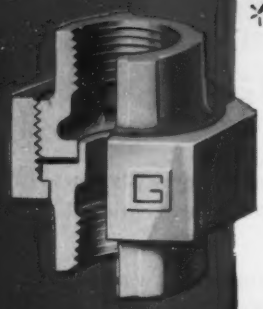
Two pioneers in the water heating field are among the leaders in the fight against corrosion in hot water systems. They are Thomas McGeachie, president of C. I. Baker Inc., and Charles I. Baker, director and chief engineer. They headquarter in Lorain, Ohio.

Using a device developed and patented by Baker, they are preventing hot water system corrosion in school, hospital, motel and manufacturing plant installations.

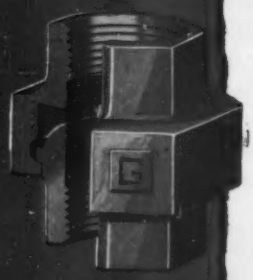
Basic to the operation is Baker's de-aerator—the device that suppresses corrosion in water heating systems. The method involves rapid application of vacuum to the heated water, which sets dissolved oxygen free so that it may be discharged into the atmosphere. The principle may be applied to water heated for hot water uses, or to water being fed into a boiler to supply steam heat.

De-aeration has been known and used for more than half a century. Baker's equipment, however, is said to be the first to simplify the process of gas removal on an economic basis.

GRABLER PIPE UNIONS



Malleable Iron Standard Union (Gasket Type)



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★ Listed by Underwriters' Laboratories as standard for Hazardous Liquids. 300 pound Unions meet Federal Specifications WWU-536. AAR Unions conform to standards of the American Association of Railroads.

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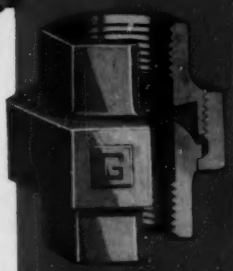
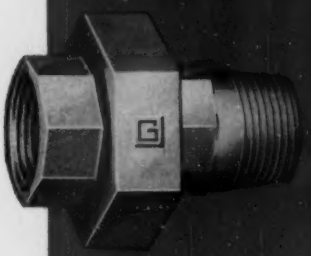
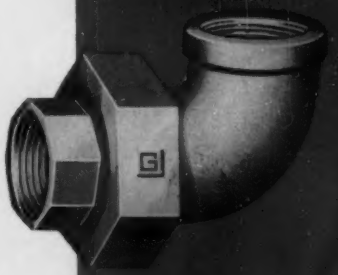


Malleable Iron Ground Joint Union • Brass Insert Seat • Tested Railroad Type



Malleable Iron Ground Joint Union • Brass Insert Seat • Tested Railroad Type Male and Female Ends



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42,000 FEET OF X-TRU-COAT FOR UNITED REFINING COMPANY

New 4" line connects refinery to tank farm

United Refining Company's new plastic-coated pipeline replaces a conventional bare line.

United Refining Company, Warren, Pennsylvania, chose X-TRU-COAT for corrosion-resistance, for ease of installation, and for overall economy. They have found that the pipe is not subject to electrolysis nor is it damaged by water-soaked ground. The 42,000-foot pipeline was installed in less than four weeks by an eight-man crew with a side-boom tractor and back-hoe. Pipe was buried three feet below the surface (just below the frost line).

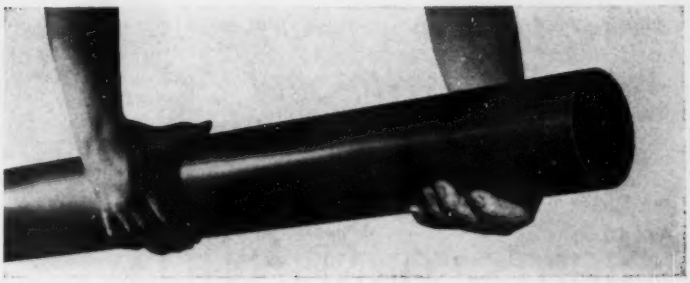
X-TRU-COAT's high density polyethylene coating resists shipping, stringing, and backfilling damage. It is extruded over a special Republic bonding compound that prevents underfilm migration. After welding, exposed joints are wrapped with primed, pressure-sensitive plastic tape that is homogeneous with the polyethylene coating.

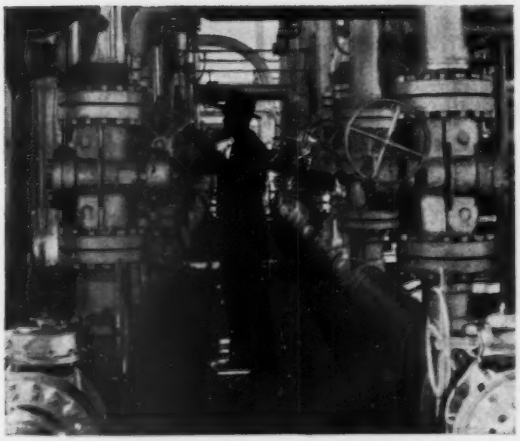
Republic X-TRU-COAT* merits your investigation. Utilities have capitalized on more than 28,000,000 feet of this factory-coated line pipe in less than three years.

*Produced under the DEKORON® Process and available now in 1.050" to 8.625" OD.

SAVED TIME AND MONEY: Western Electric utilized plastic pipe for an intricate, 30-acre lawn sprinkling system at their Oklahoma City telephone accessories plant. Republic Steel supplied 21,460 feet of 1¼″ through 3″ SRK® Plastic Pipe rated at 100 psi. Installed by Southwest Irrigation Company, the system called for 53 different watering circuits to operate four at a time. A clock-like device—designed by Southwest Irrigation—completes a sprinkling automatically in approximately 16 hours. Send for data on SRK Plastic Pipe.

LIGHT WALL LINE PIPE: ideal for low pressure gathering and distribution applications. You save up to ⅓ the weight, ⅓ the cost. Available in 1.315″ through 4.500″ OD, Republic Light Wall is manufactured to applicable parts of API Specification 5L. Factory-applied X-TRU-COAT polyethylene coating can be specified (at extra cost) in all these sizes. Return coupon for data.





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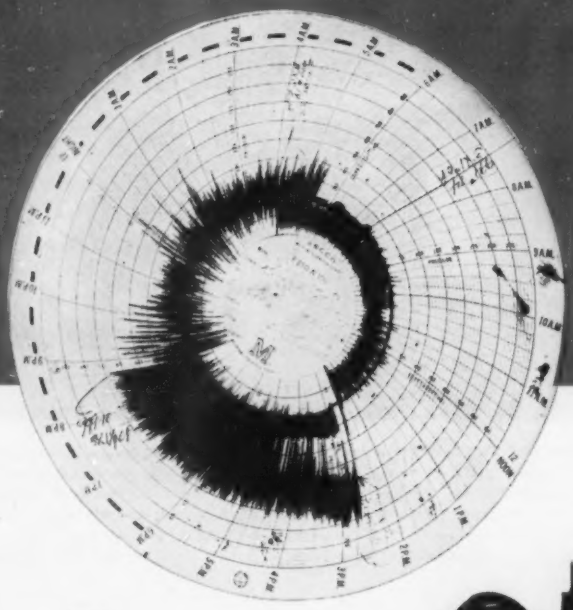
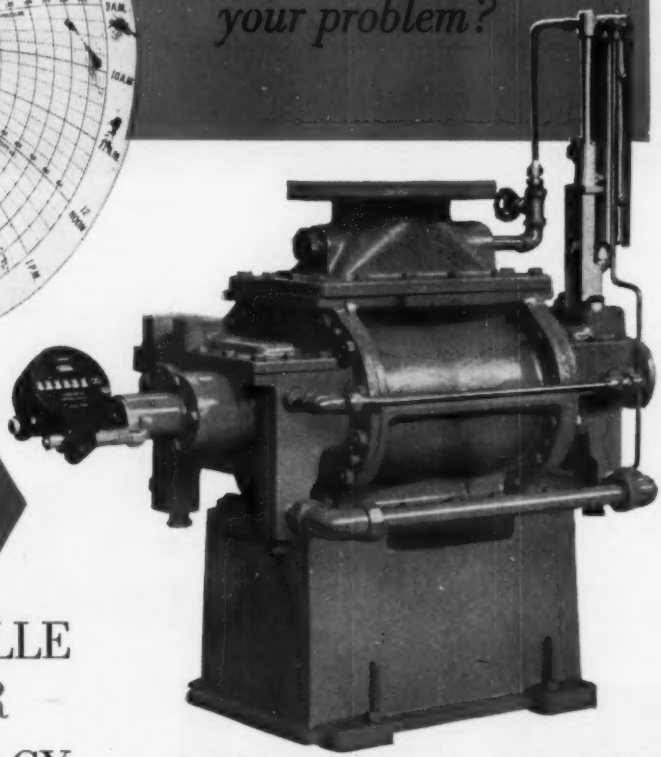


Are "paint brush" charts like this your problem?

Here is your easy-to-read solution.



ROOTS-CONNERSVILLE ROTARY GAS METER MAINTAINS ACCURACY AND READABILITY, EVEN WHEN FLOW RATES FLUCTUATE RAPIDLY

Troubled with "paint brush" charts from an orifice-type recording meter used for testing wells, Shell installed the R-C Rotary Meter and now obtains clear and accurate data recorded on a punched tape along with other well test information.

At Shell Oil offshore installations in the Gulf of Mexico, the oil and gas output of 16 or more wells passes through a single gathering platform before being piped to gas transmission lines, storage tanks and refineries. The gas flow from each well must be measured at intervals so that oil-gas ratios can be determined. Pressure in the well to be measured is reduced to 40 psig for metering, the oil separated, and the gas piped into a 4 x 8 high-pressure R-C rotary positive displacement meter. After a selected period of testing, this well is returned to normal operation and the next well switched in to test. The operation is continuous and automatic on whatever time cycle is chosen. The orifice meters previously used for measuring gas flow recorded the fluctuation in flow in such a way that instrument charts were difficult to integrate. Maintenance requirements were high and frequent chart readings necessary.

The R-C rotary meter accurately measures the fluctuating flows from each well and this accuracy is unaffected by continuous fluctuation. Well pressures range from 50 to 2000 psig. Direct readings, corrected to standard conditions can be taken from the meter or transmitted remotely. No stand-by personnel is needed to service the meter or read charts. Repetitive flow readings can be obtained to determine accurate oil-gas ratios.

R-C rotary positive displacement meters were selected as a result of field tests, which proved them most accurate in measuring the wide range and rapid fluctuations in flow rates.

ROOTS-CONNERSVILLE BLOWER
DIVISION OF DRESSER INDUSTRIES, INC.
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For additional data, please refer to pages 565—568 in Chemical Engineering Catalog or write for Bulletin M—258.

TECHNICAL TRENDS

By GUY CORFIELD
Professional Engineer,
Los Angeles

Engines, Old and New

A favorite expression nowadays is "population explosion" but keeping pace with the birth increase that has developed this expression, there is also a technical explosion. Not only are many new ideas and principles being developed, but also old ones are being remembered, revived, modified and improved to take their place in the march of progress.

An excellent example is the free piston engine which has recently intrigued and encouraged the gas industry. The principle has been known for many years but it took a need—the need of the gas industry for efficient gas fueled prime movers for air conditioning and general power purposes—to stimulate the application of modern technology and ingenuity. As a result the free piston engine compressor is at the commercial development stage in the capable hands of the Robertshaw-Fulton Controls.

Another engine, the principles of which have been known for a century, is the Sterling thermal engine named after Robert Sterling, its inventor. It is an *external combustion* engine in which heat as non-odorous and non-toxic combustion products is applied to the *outside* of the engine cylinder. The working gas, which can be air, is sealed within the engine and passes through a thermodynamic cycle to operate it. First there is isothermal compression with heat removal, then constant volume heat addition, then the power stroke from isothermal expansion with heat addition, and then constant volume cooling. Advantages claimed, beyond clean exhaust gases, are high efficiency and quiet operation. Disadvantages are cost and, in small sizes, weight.

The control of this engine principle has been in the hands of the Philips' Company of Eindhoven, Netherlands, and negotiations for its development in the U. S. have not heretofore been attractive. General Motors, however, has apparently broken through. GM recently revealed that it has been studying this Sterling engine for some time, and set up a cooperative research project with the Philips' Company in 1958, for development for American commercial and military use. GM Research Lab. engineers told a recent SAE meeting that two full size engines have been built which give encouraging test results and have led to improvements in design. A portable engine-powered electric generator unit is being built in contract with the U. S. Army Research and Development Labs., and general development efforts are continuing.

The gas industry will of course follow this with great interest as gas would seem to be the ideal fuel for such an engine.

U. S. Government Office of Technical Services

One of the problems in research is to find out and keep up with what has already been done and what is currently going on. An agency specifically created for this purpose is the U. S. Department of Commerce Office of Technical Services. Incidentally, it takes a little research to find out how to obtain information from this agency.

OTS was formed to "establish and maintain within the Department of Commerce a clearing house for the collection and dissemination of scientific, technical and engineering information . . . from whatever foreign and domestic sources that may be available . . . and to make such information available to industry and business . . . and to the general public, through the preparation of abstracts, digests, translations, bibliographies, indexes and microfilm and other reproductions . . ." Also OTS "helps industries develop and agree on quality, testing and rating standards for their products; serves as a point of contact for trade associations and other nonprofit trade groups . . . and as a contact point for American inventors regarding the technical problems and needs of the nation's defense agencies." It does not itself sponsor or conduct research and development programs, but since 1945 has collected more than 200,000 technical reports.

There are several ways in which information and reports can be obtained from OTS. One is to write directly to the Director, Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Or, in 33 cities in the U. S., inquire at the local "field" office of the U. S. Dept. of Commerce. A Monthly Technical Reports Newsletter is sold on subscription by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. at $1 per year. A free list of Catalogs of Technical Reports is available from OTS or at any Department of Commerce field office. A monthly bibliographic and abstract journal entitled U. S. Government Research Reports can be obtained from the Superintendent of Documents at $6 per year. A twice-monthly Technical Translations, from the Supt. of Documents, costs $12 per year. Finally, for anyone wanting to know more about OTS and its parent and related agencies, including the Patent Office, a National Science Foundation Report No. 3, Nov. 1959 (NSF59-58) can be obtained from the Supt. of Documents for 15 cents.

Automatic... continuous

15-second figuring gives total corrected flow in Bridgeport

Bristol telemetering computer system helps gas dispatcher operate near contract limit yet avoid penalty charges.

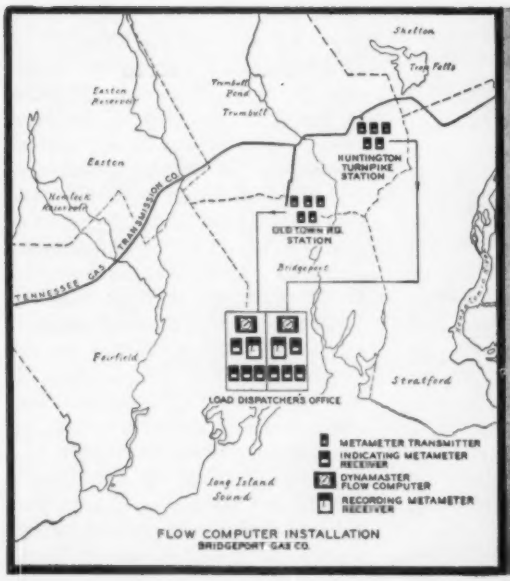
Bridgeport Gas Company, Bridgeport, Connecticut, operates in a heavily populated, heavily industrialized area. Toward the end of a peak-load period, penalty charges for exceeding the contract limit on purchased natural gas might easily amount to a substantial sum of money—even in the ten minutes it would take to compute manually the total corrected flow from their two city gates (see map), each of which is under separate contract.

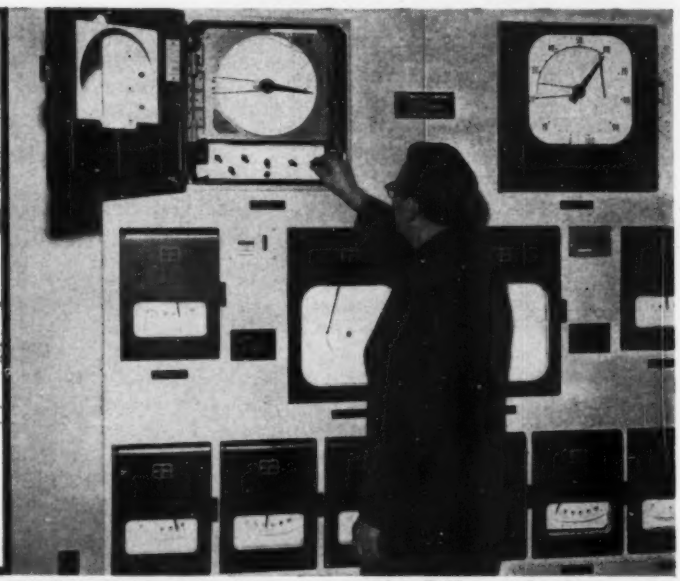
But, Bridgeport Gas has found a way to ease this problem: Their Bristol telemetering computer automatically and continuously totalizes and corrects gas flow to within the last 15 seconds of consumption. The corrected flow is presented—along with other information—in the central dispatcher's office so that he can instantly take remedial action, drawing upon "peak shaving" storage and LPG facilities, if an over-run condition appears likely to develop.

It's been estimated that savings from one ten-minute over-run, prevented in this manner could more than pay for the cost of the entire Bristol computer set-up.

This is typical of the outstanding jobs Bristol telemetering is performing today for gas pipelines and distribution companies, oil pipelines, electrical transmission networks, water plants, and industrial plants. Pressure, liquid level, flow (including total corrected flow), temperature, mechanical motion, voltage, current, and electric power are just a few of the variables that can be transmitted. Distances may vary from a few yards to hundreds of miles. Almost any transmission medium may be used: telephone lines, carrier current, and radio—microwave, VHF and UHF.

Let us send you more data on Bristol telemetering. And, of course, thoroughly experienced Bristol applications engineers are always ready to talk over your specific problems with you. Write: The Bristol Company, 119 Bristol Road, Waterbury 20, Conn. 0.28





This Bristol Telemetering Computer Panel gives Bridgeport Gas Company dispatcher complete data *in seconds* on pressure, temperature, and corrected totalized flow of purchased natural gas. Flow-computing Dynamaster* instruments for each station (see map) are at top of panel; integrating counters are directly below them. *T.M. Reg. U.S. Pat. Off.

BRISTOL... for improved production through measurement and control

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

WASHINGTON

By NEIL REGEIMBAL
GAS Washington Bureau
1093 National Press Bldg.
Washington 4, D. C.

New faces of 1961

UNCLE SAM will wear a new face in 1961 no matter which candidate or party wins the White House and the Congress in November.

The visage produced over the past seven years by President Eisenhower's middle-of-the-road Republican Administration and a Democrat-controlled Congress will fade whether his successor is Nixon or Kennedy.

Gas industry executives, as businessmen and as suppliers of one of the country's major fuels, will feel the impact of the changing America—changes forced by pressure from overseas and by domestic political shifts.

Careful study of both the Republican and Democrat party campaign platforms, and of the personalities and statements of the candidates, points to important changes in federal government policies whichever way the majority of voters turn.

For instance, higher taxes will have to come to support the bigger defense and welfare proposals of both party champions. In spite of this year's budget surplus of $1.1 billion, no major tax cuts are in sight for business or personal taxpayers in the foreseeable future. Question is how much they will rise.

Democrat Kennedy's election platform would produce spending boosts estimated at $12 billion. His tax proposals, based heavily on "closing loopholes," would recover less than half of this.

Republican Nixon's proposals would boost government spending by perhaps $3.5 to $5 billion. Again, his "tax reform" policies might recover some of this.

But in either case, if Congress picked up either candidate's entire program, mammoth tax boosts would be required to finance the government. Chances are that the lawmakers will take only part of either program, and then only over several years. But the major item of expense in both cases is higher defense spending—so some new revenue will probably have to be found by 1962.

There will be some "tax reform" legislation drafted by then. The House Ways and Means Committee has taken the first steps toward this tax overhaul. While there may be some minor tax cuts resulting from this reform, they'll be more than offset by tighter tax deduction laws, and a slight net gain in government revenue is in prospect.

Neither candidate will be bound strictly by the specific language of their party's campaign platforms. But as a guide to what the gas industry may expect, the platforms are revealing.

In some of the areas directly affecting the industry, here is a quick comparison of the two campaign banners:

Depletion—The Democratic platform makes specific mention of "closing the loopholes in the tax laws by which certain privileged groups legally escape their fair share of taxation." As in the past, the Democrats have included depletion in its list of loopholes. The Republican platform makes no specific mention of gas and oil rates, but intimates support of present levels in a plank saying: "Continued support for federal financial assistance and incentives under our tax laws to encourage exploration for domestic sources of minerals and metals, with reasonable depletion allowances."

National Fuels Policy—The platform adopted by the Democrats goes all the way, promising to:

Continued on page 133

Good neighbor policy or not, Canadian government officials are letting it be known they want no part of any regulation of Canadian gas prices by the FPC.

When FPC Hearing Examiner Robert Weston in the Pacific Gas Transmission Co. case conditioned approval on submission of complete reports of prices, profits, costs of Canadian supply and affiliated companies through the U. S. firms involved, the Maple Leafers stiffened their backs.

The Provincial Minister of Alberta immediately protested the suggestion that the FPC would "attempt to regulate natural gas prices to the producers in Alberta."

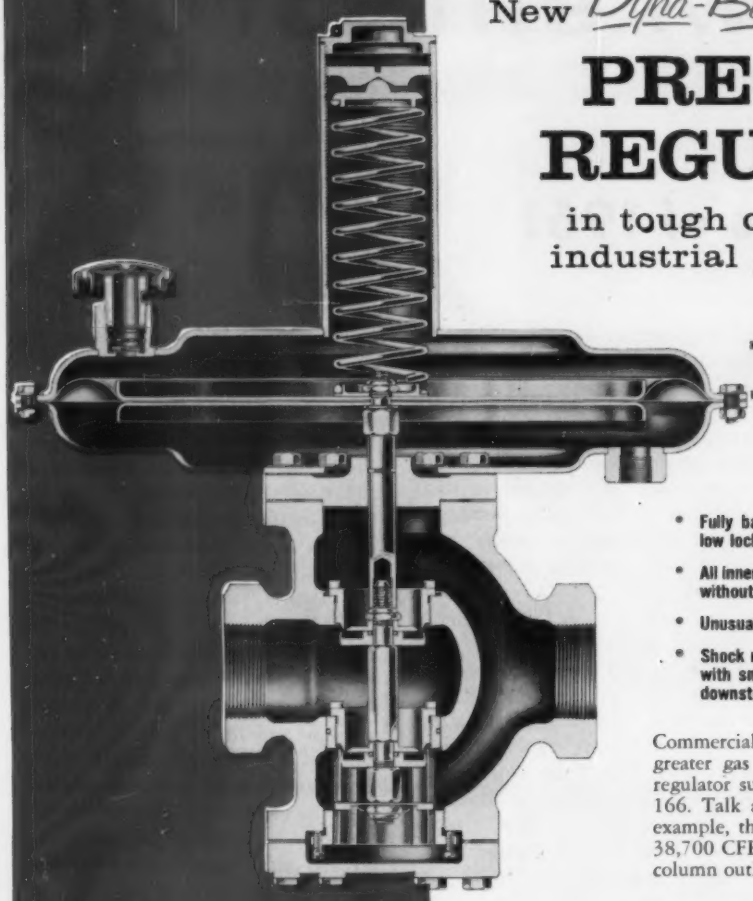
In answer to a question in the House of Commons, Canadian Minister of Trade & Commerce Gordon Churchill said the Canadian government would "most certainly" file an official protest if the full FPC approved the examiner's recommendations and did attempt to set gas prices in Alberta.

At an oral argument on the recommended decision, spokesmen for both the U. S. and Canadian companies bitterly protested the proposed financial reports.

New *Dyna-Balance* Principle for

PRECISION REGULATION

in tough commercial and industrial gas applications



FISHER

TYPE 166

- **Fully balanced inner valve provides positive shutoff at low lockup pressure**
- **All inner valve parts easily removable through blind flange without removing regulator from line**
- **Unusually large capacity throughout its performance range**
- **Shock resistant! Controlled pressure holds constant even with snap-acting solenoid valves opening and closing in downstream system**

Commercial and industrial installations requiring greater gas volume have long needed a heavy duty regulator such as the new Dyna-Balance Fisher Type 166. Talk about high capacity—the 166 has it! For example, the Type 166-2 with 1⅞″ ports will pass 38,700 CFH of gas with a 5 psi inlet and a 7″ water column outlet.

The Dyna-Balance Story

The 166 Series incorporates a boosting principle called "Dyna-Balance". Dyna-Balance minimizes the effect of the main spring on outlet pressure as the flow increases, so that under most pressure and flow conditions the outlet pressure is actually increased with increases in flow. This gives extremely high capacity with little change in controlled pressure.

OUTLET PRESSURE = 7″ W.C.		
INLET PRESSURE	TYPE 166-1	TYPE 166-2
	CAPACITY SCFH 0.6 Sp. Gr. GAS FLOW	CAPACITY SCFH 0.6 Sp. Gr. GAS
5 PSIG	17,000	38,700
10 PSIG	25,800	58,000
20 PSIG	40,200	87,600
30 PSIG	51,000	113,500
40 PSIG	62,200	135,500
50 PSIG	73,400	161,000
60 PSIG	85,500	187,000

Construction Data

Regulator is available in two constructions. Type 166-1 has 1″ diameter ports and either 1½″ or 2″ screwed, and 2″ 125 pound flanged bodies. The inlet permits up to 125 psi, and outlet 4″ W.C. to 10 psi. There are seven different springs available. Type 166-2 has 1⅞″ diameter ports. Body size is 2″ screwed or 2″ 125 pound flange. Pressure range for the inlet is up to 60 psi. Outlet range is 3″ W.C. to 5 psi. 166-2 has six springs available.

For Further Information Write For Booklet P-166

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY

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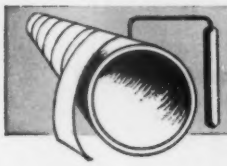
BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIP. CO., CORAOPOLIS, PA.

FISHER® Controls

SINCE 1880



CORROSION PREVENTION DISTRIBUTION TRANSMISSION

Some popular superstitions

By **MARSHALL E. PARKER**
Consulting Engineer
Houston

A SUPERSTITION is usually defined as a belief or practice with an incorrect or an inadequate basis. This does not say that the belief is untrue or that the practice is unsound; it merely says that it is based either on a misconception or on insufficient data. Very often a superstition is partly true; that is, it contains just enough truth to make it very difficult to refute, and yet it is not really true.

In the field of electricity, as it is applied to and as it affects pipeline corrosion and cathodic protection, there are several beliefs and practices which, according to the above definition, must be classed as superstitions.

(1) A pipeline can be "insulated" from ground. This one is partly true—but not in the sense that is implied by the use of the word insulated. The best coatings which we have available for pipelines have a high, but finite, resistance; the cathodic protection current "leaks" rather badly, as compared with a power cable or similar electrical conductor. Actually, since the copper conductor of a buried cable is very effectively insulated from the ground, it must be possible to do the same thing with a pipe; but not with the coatings which are presently available.

(2) A coated pipeline can be "grounded." Again, this is partially true. A holiday in the coating, a connection to a bare valve or bare flanges, any such circumstance serves to decrease the resistance of a coated line to earth, However, the decrease merely represents a change in the numerical value of the resistance, not a fundamental change in the condition of the line from "ungrounded" to "grounded." Such an occurrence, for example, may represent an almost infinitesimal increase in the amount of current needed for cathodic protection; the increase is often too small to measure.

(3) Water can short-circuit an insulated joint. This is a near relative of the last one. Water—or soil—surrounding an insulated joint, particularly when the flanges have been left bare, can decrease the resistance path from one line section to the other. However, the resistance is quite large as compared with an actually short-circuited joint, and the path is an electrolytic one rather than metallic. The resistance of the soil path is usually somewhere between 100 and several thousand times as great as a solid metallic path would be.

There may sometimes be some damage done to the line on one side of such a joint, if there is a sufficient potential difference between the two sections, by current leaving the pipe, flowing through the soil or water around the insulation, and then returning to the pipe. The damage is done to the section from which the current flows to the soil. If one section is under cathodic protection and the other is not, then the damage (if any) will be done to the section which is *not* under protection.

The same discussion pertains to the interior of a line which is carrying a conductive electrolyte—for example, salt water. Very seldom are conditions found under which fresh or potable water would cause any detectable damage in this way; even with salt water, the damage in many cases is quite negligible.

(4) A grounded structure is at ground potential. To say that anything is at "ground potential" is, in effect, to say that there is such a thing as ground potential — that the earth is everywhere at the same potential. This is far from true; there are all kinds of potential gradients in the earth, and they are by no means static. How, then, can any structure be brought to and kept at ground potential? Of course, from the standpoint of power voltages—66,000 v or higher —"ground" potential is virtually constant. This is true even of much lower voltages, down to the familiar 115-v house circuits; for the fluctuations normally found in ground potential are on the order of 1 v at the most. But, although "ground potential" is a meaningful and useful term in power transmission, it can be a misleading one in corrosion problems.

There is still another, and more important, reason for caution in the use of the term. A metal structure in contact with an electrolyte has a characteristic contact potential with that electrolyte. True, this potential alone cannot be measured; there is some question as to whether it can even be defined; but the algebraic sum of two of these potentials can be measured. And these combination potentials — the difference in the potentials of different metals in contact with the earth, acting as an electrolyte—are of very great importance in corrosion, for they are responsible for a large amount of corrosion. They are also responsible for the operation of one of the potent weapons we use in our battle against corrosion—galvanic anodes, such as magnesium or zinc.

(5) Electricity follows the path of least resistance. Every electrical engineer knows better than this, but the best of them sometimes act as if they believed this. The fact is, of course, that the elec-

Continued on page 77

Another new development using

B.F.Goodrich Chemical *raw materials*

Now gas comes home through pipe of Geon

The pipe in this natural gas distribution system is made of Geon rigid vinyl. Years from now it will be feeding gas to homes just as efficiently as the day after installation. This pipe stays smooth inside and out because it is not affected by the corrosive influences that affect ordinary pipe. No problems from salt water, chemicals, acid or alkaline soils, or galvanic corrosion.

Conduit or pipe made of Geon provides high tensile and impact strength. It stands up under pressure, resisting effects of fungi, bacteria, moisture, heat or cold. It makes a big hit with installation crews, since it is so light weight and so easy to install.

Engineers are taking advantage of the properties of versatile Geon polyvinyl material for this and many other types of applications. For information, write Dept. GS-5, B. F. Goodrich Chemical Company, 3135 Euclid Ave., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

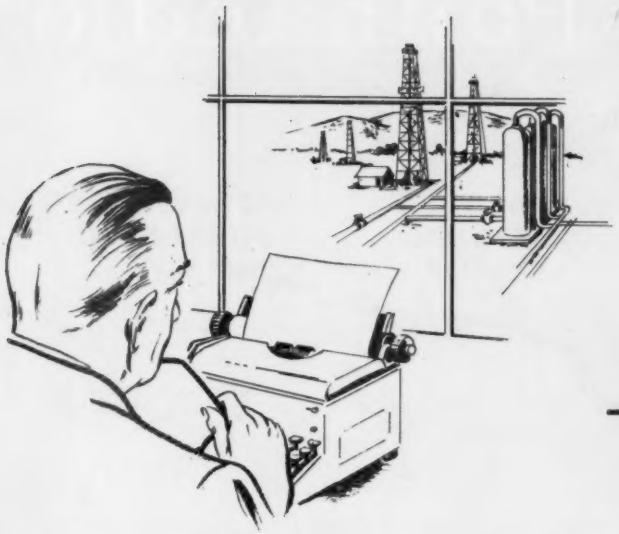
1¼" diameter pipe of Geon rigid vinyl is being installed by Illinois Power Company in gas lines leading to homes at Decatur, Illinois. In addition, ¾" vinyl pipe is being inserted in reamed-out 1¼" iron pipe under streets to avoid breaking the pavement to repair leaking gas lines. Kraloy Plastic Pipe Company, Los Angeles, California, makes the pipe. B.F.Goodrich Chemical Company supplies the Geon rigid vinyl.

Geon VINYLS

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich

GEON vinyls • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers



THE GASSING GAME

By JIM CLARK
Gas & Oil Consultant, Houston

NATURAL gas producers seem to believe that legislation which will free them from the utility-type regulations imposed by the Supreme Court's decision in the Phillips case is possible in the next congress.

They have three good reasons for this hope being higher than ever.

In the first place, in spite of the other petroleum industry discouragements in the Democratic platform, like the threat of lowering depletion provisions and the advocacy of a national fuels policy, the platform says nothing in support of federal regulation of gas producers.

The second good reason is a public statement by Republican candidate Richard Nixon in Houston in June that he had voted for the Harris natural gas bill and that he believes the principles of that bill are sound and would continue to support such legislation.

But the most important optimism of all on the part of producers comes from a new spirit of understanding and cooperation that has developed between producers, transmission companies, and distributors. Especially are the producers encouraged over the fact that they can now sit down at the table with distributors and discuss common problems.

Several years ago when the Natural Gas and Oil Committee was fighting (successfully) for the passage of the Harris-Fulbright bill (which President Eisenhower vetoed), the relationship between producers and distributors was anything but good. The producers at that time felt that they had some influence in helping distributors get free of federal controls and that distributors had not only failed to respond in kind when the producer legislation came up, but had actually and openly opposed the Harris-Fulbright bill.

In its campaign to enlist aid for the Harris - Fulbright bill, the NGOG had placed some advertisements in large eastern newspapers that had unfortunate implications which apparently embarrassed and angered distributors. So, in addition to the veto, the producers found themselves at loggerheads with their customers, the distributors.

This condition, as most people in the gas business know, existed for some time afterward. But last year both sides seemed to recognize the existence of important mutual interests. Distributors seem to have come to the conclusion that continued utility-type regulations on producers are going to result in drying up sources of gas and eventually in the end of their own business. This realization has come about due to the intelligent efforts of some of the leading producers who have taken their story directly to the distributors.

In recent months a series of meetings has been held, and now it seems that all segments of the natural gas business are in agreement. Their prime objectives are survival and public service. Without sources of supply, distributors cannot continue to survive or perform that service. In the long run it would not be only the distributors, transmission lines, and producers that would suffer. Far more important would be the public interest.

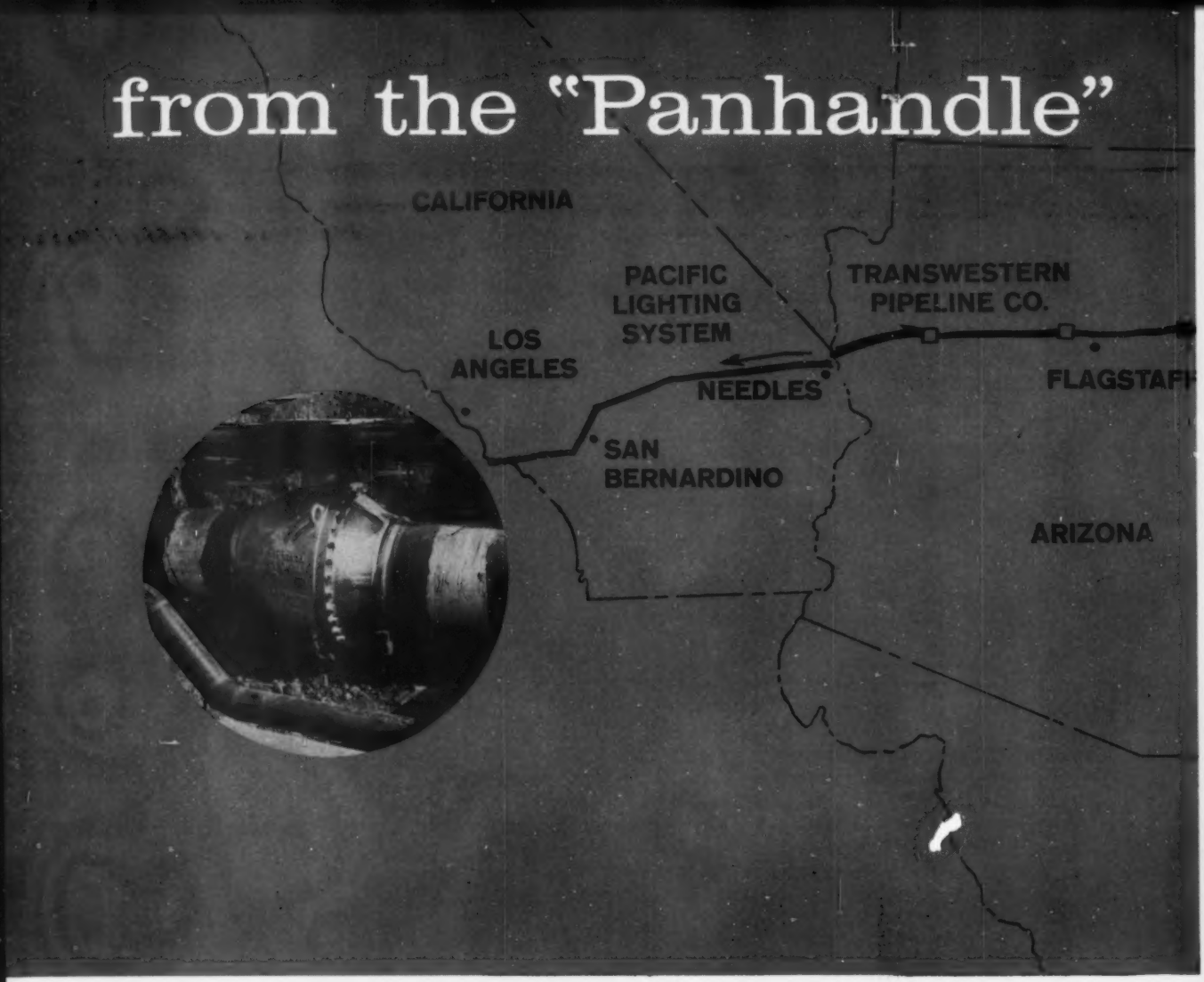
It is in this atmosphere that present hopes for understanding and progress seem to be getting brighter. Producers know they have virtually no influence on or communication with the public outside the three or four largest producer states, whereas the distributors maintain constant communications with the public wherever gas is used.

Most producers I have talked with are enthusiastic about the new rapport with the other segments, but especially with the distributors. They see how they can get their message over to the people who understand so little the position of the producer, as well as his indispensableness to the entire complex of natural gas.

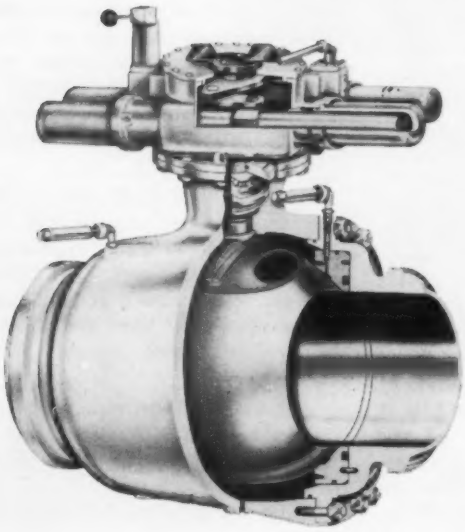
There is little doubt that certain members of the Congress will still fight to continue utility-type regulations of producers, but their number will diminish as public understanding of the complicated problems involved becomes more complete.

And that is why most gas producers have high hopes for relief from the present impossible conditions under which they cannot hope to exist for very much longer. ■

from the "Panhandle"



Modern ROCKWELL HYPRESPHERE

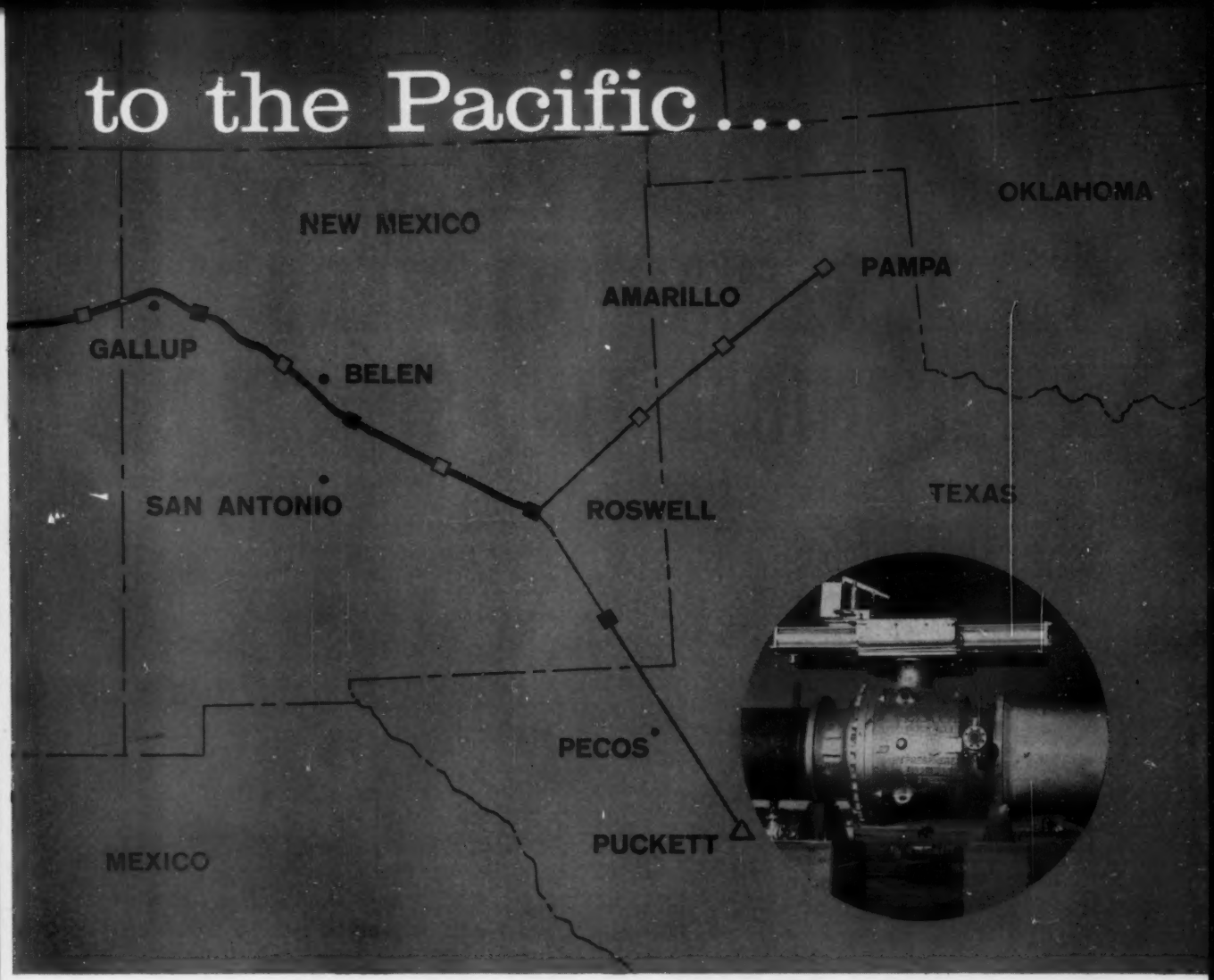


The new gas transmission network shown above brings an initial capacity of 300 MMcfd to help fill the ever-increasing demand of dynamic Southern California for natural gas. This modern network, stretching across four states, will be operated by Transwestern Pipeline Co. and Pacific Lighting System. The pipeline system uses the latest advances in telemetering and remote control techniques for simplified, efficient operation and supervision.

With advanced thinking applied to every phase of the system's design, it was logical that Rockwell Hypresphere valves should have been chosen for 24", 30", 34" and 36" main line valve services—for these lubricated plug valves are the most modern pipeline valves ever designed.

Compact and bi-directional, Rockwell Hy-

to the Pacific...



VALVES used for main line service

presphere valves require only a quarter-turn to open or close. And, since they are of the famed Rockwell *lubricated* plug design, they are turned quickly and easily by power operators, making remote control operation fast and sure. Rockwell Hypresphere valves provide tight shut-off too, and are self-adjusting, requiring less maintenance. In addition, the full-round opening of the Hypresphere makes it ideal where on-stream pigging is planned—as it was on this "Panhandle to Pacific" system.

For more information on these outstanding valves for pipeline service, write Rockwell Manufacturing Company, Dept. 101-J, Pittsburgh 8, Pa. or Rockwell International, S.A., Geneva, Switzerland; Canadian Valve Licensee: Peacock Brothers, Limited.

ROCKWELL-Nordstrom VALVES

another fine product by

ROCKWELL

Rockwell Manufacturing Co.
Pittsburgh 8, Pa.

Gentlemen:

Please send me further information on Rockwell Hypresphere valves. Bulletin V-607.

Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

Texas utilities contractor reports:

"OUR 774 CUTS 25-200% MORE TRENCH THAN DITCHERS WITH MECHANICAL TRANSMISSIONS"

"We know for a fact our Barber-Greene 774 Ditcher with dual-range Hydra-Crowd transmission cuts 25 to 200% more ditch daily than mechanical transmission ditchers we've used," says H. W. McCurley, of Pearson & McCurley, Beaumont, Texas, utilities contractors.

"Actually the 774 revolutionizes ditcher design with a hydraulic control system that gives the operator fingertip control of forward crowding speeds, boom hoist, discharge conveyor drive . . . all independent of wheel digging speeds. And our operator sure likes the instant dialing of maximum crowding speed for any ground condition.

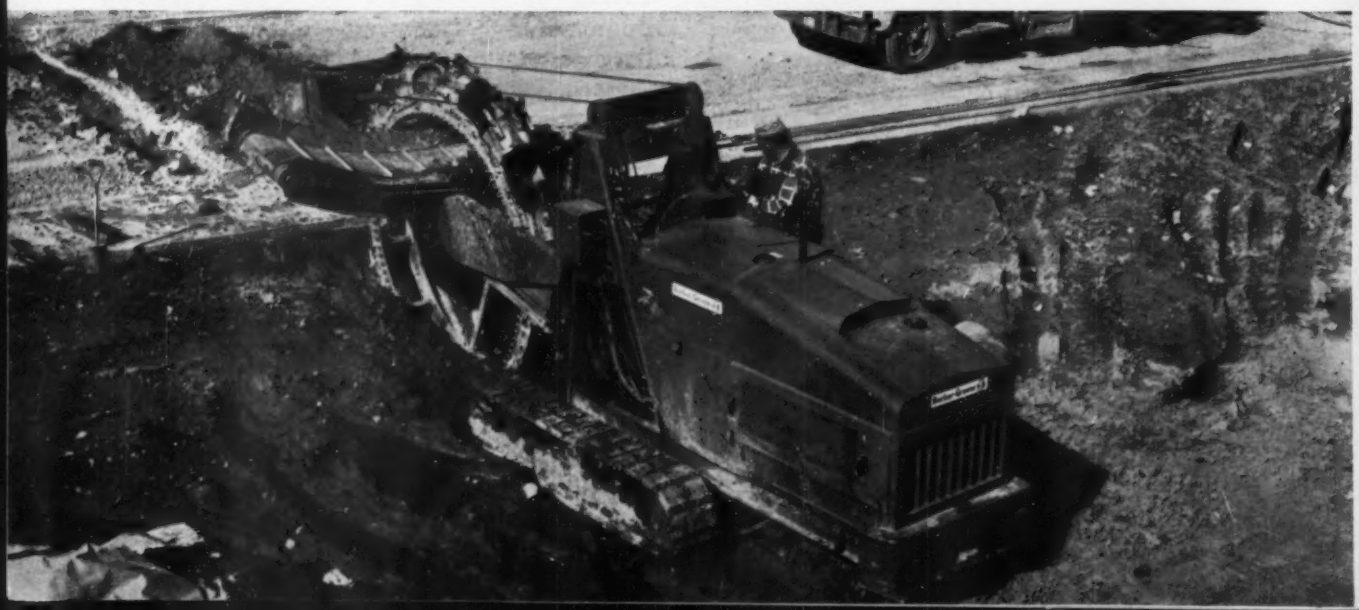
NO PARTS REPLACEMENT—"In ditching 36,000 feet, we've had no parts replacement . . . never changed digging teeth, side cutters or gumbo cutting lips on fingerback buckets," he recalls.

This Texas firm bought its 774 after renting one from a contractor. Your Barber-Greene Distributor will take you to a job and show you the ditcher you are interested in so you'll get all the facts. Call him today.

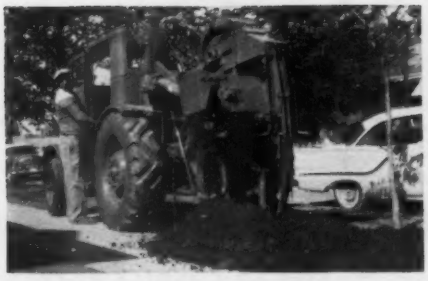
Midwest utility company
OWNS FLEET OF OVER 25 BARBER-GREENES

This Barber-Greene dug in record time the street mains and over 300 services in one subdivision, keeping well ahead of the crew that was welding, wrapping and lowering in. Owned by a major midwestern gas utility, the Model 773 shown below is only one of the more than 25 Barber-Greene Ditchers in their fleet.

For close quarter operation, Barber-Greene's 772, identical with the 773 except for narrower track gauge and pad width, works within 19" of side obstructions. All three utility ditchers have dual-range Hydra-Crowd transmission, exclusive digging wheel drive with fully guarded chains, automatic overload protection, shock-absorbing flexible drawbar, hydraulically driven spoil conveyor with rubber-impact rollers, and fewest wearing parts for minimum maintenance. Model 774 is available with 5½ or 7' wheels and cuts from 18-30" wide. Models 773 and 772 trench to 5½' deep and 10-24" wide.



On jobs in Beaumont and Orange, Texas, installing pipe from 8" to 16", Pearson & McCurley's 774 with 5½-ft. wheel dug up to 2,500-ft. daily in tough gulf coast gumbo. "Has plenty of reserve to dig far beyond our daily needs," says Mr. McCurley.



Rubber-tired or crawler mounted Barber-Greene Vertical Boom Ditchers cut lowest cost trench from 5½" to 24" wide and to 7' deep. Model 705-B, shown, digs to 4'8" deep.

Manufacturer of the only modern ditcher line

Representatives in Principal Cities of the World

Barber-Greene BG

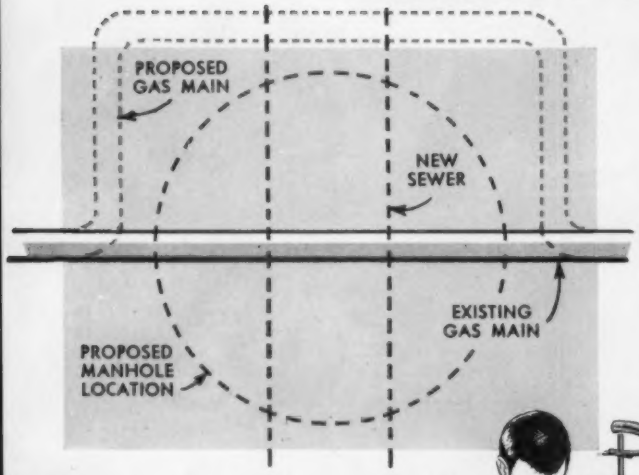
Main Office and Plant AURORA, ILLINOIS, U. S. A.
Plants in DeKalb, Illinois..Detroit..Canada..England..Brazil..Australia

CONVEYORS • LOADERS • DITCHERS • ASPHALT PAVING EQUIPMENT

RELOCATE GAS LINES QUICKLY and SAFELY with

MUELLER® NO-BLO® METHOD

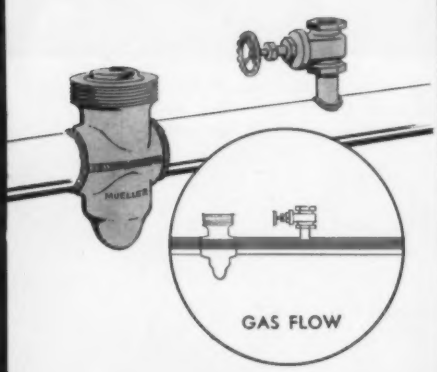
Machines and Equipment

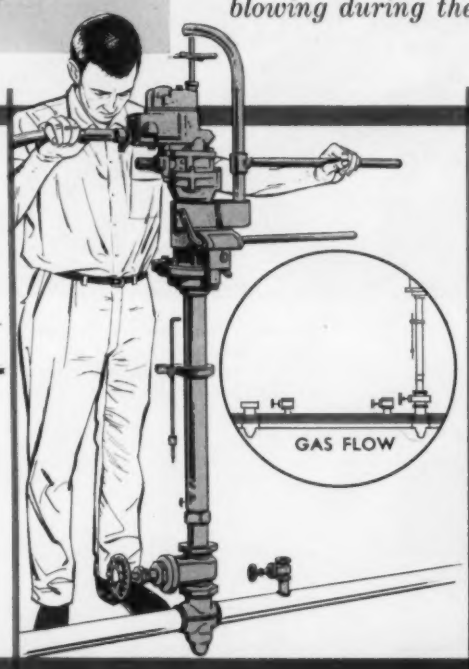


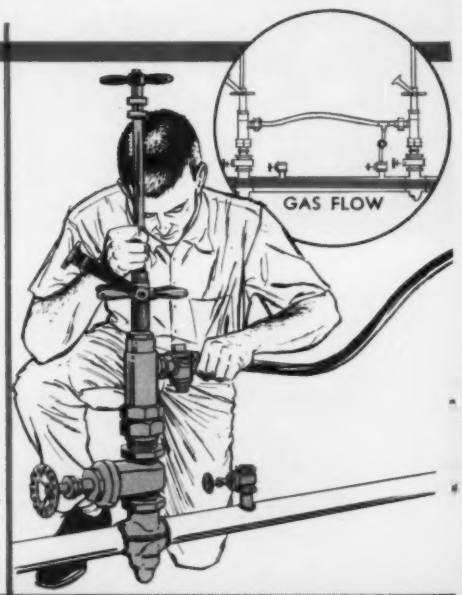
■ Recently a new sewer trunk line and manhole installation posed a tough line relocation problem for a gas utility company. Serving an industrial and residential area, service could not be interrupted during relocation of the line.

This schematic diagram of the problem and the step by step illustrations show how the line was relocated with Mueller No-Blo Method Line Stopper Fittings and Equipment . . . *without interrupting service* and *without gas blowing during the entire operation.*

here's how:







STEP 1 ATTACH FITTINGS

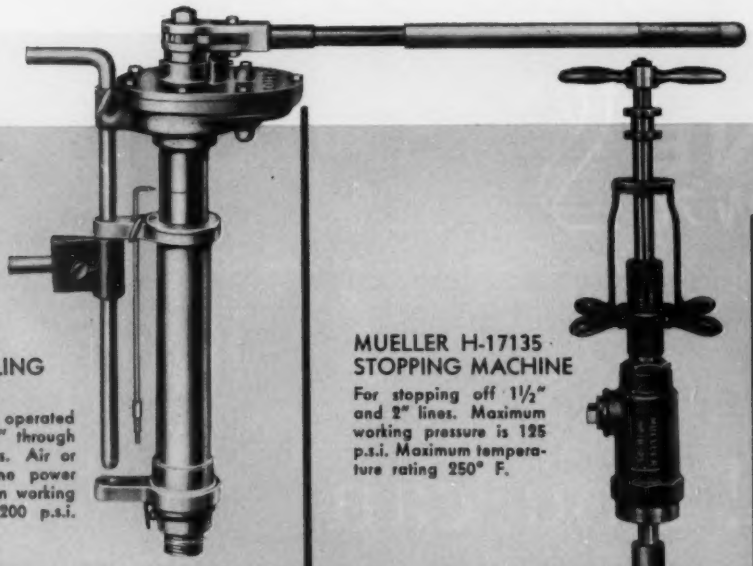
Weld Mueller Line Stopper Fittings to main on each side of section to be relocated. Weld Save-A-Valve Drilling Nipples to line providing by-pass and purging connections. Attach gate valves to drilling nipples.

STEP 2 DRILL MAIN

Attach special Mueller gate valve to stopper fitting. Attach DH-2 Drilling Machine (or D-4 Drilling Machine) to gate valve. Make cut, retract drill, close gate valve and remove drilling machine. Repeat cutting operation in second line stopper fitting and Save-A-Valve Drilling Nipples.

STEP 3 CONNECT BY-PASS

Attach line stopper to H-17135 Stopping Machine and attach Machine to gate valve. Connect by-pass line between the H-17135 Stopping Machines. Purge by-pass, then start flow through the by-pass line.

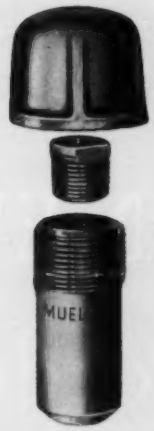


MUELLER DH-2 DRILLING MACHINE

Power or hand operated for drilling ¼" through 2⅛" diameters. Air or gasoline engine power units. Maximum working pressure of 1,200 p.s.i. at 100° F.

MUELLER H-17135 STOPPING MACHINE

For stopping off 1½" and 2" lines. Maximum working pressure is 125 p.s.i. Maximum temperature rating 250° F.



SAVE-A-VALVE DRILLING NIPPLES

Welding or threaded inlet nipples available for 250 p.s.i. or 1,200 p.s.i. service. Sizes from ¾" through 3".

For complete engineering and No-Blo Method information, write direct.

MUELLER CO. since 1857 SERVING the Water and Gas Industries QUALITY

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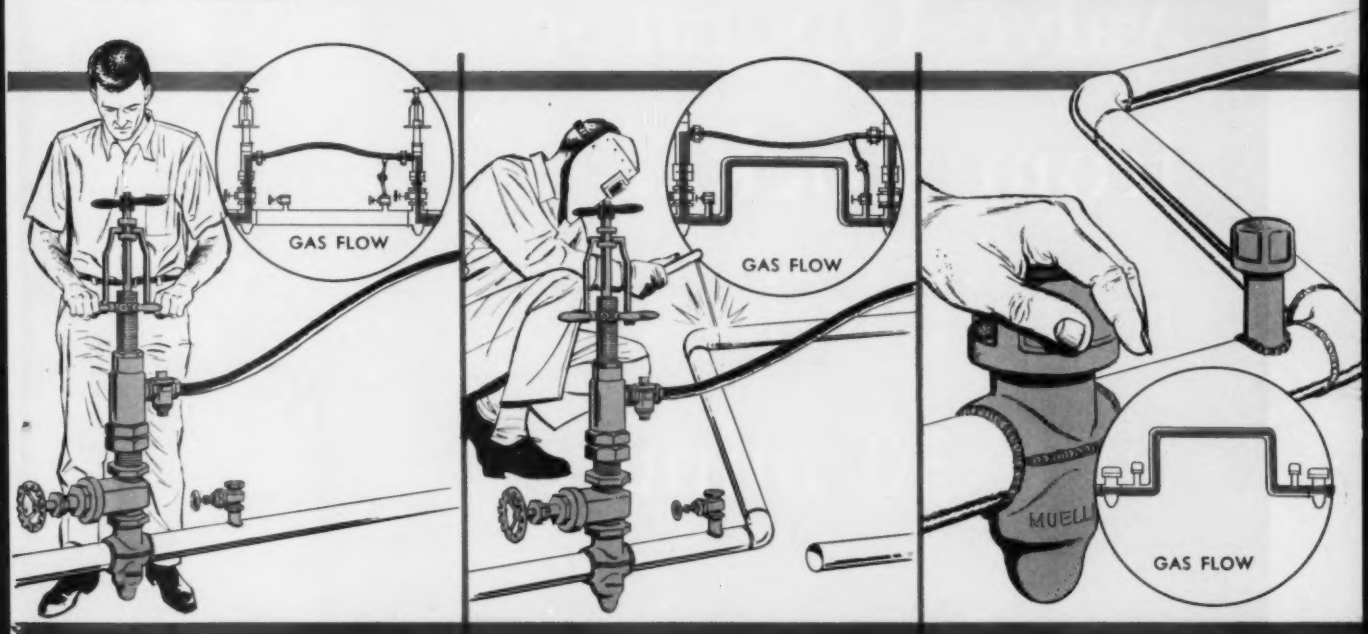
Factories at: Decatur, Chattanooga, Los Angeles; In Canada: Mueller, Limited, Sarnia, Ontario.



STEP 4 STOP-OFF

Open gate valve on upstream stopper fitting, insert and expand stopper. Repeat stop-off operation on downstream stopper fitting. Section is now isolated.

STEP 5 RELOCATE MAIN

With by-pass line maintaining flow of gas without interruption or shut-down, the isolated section can be removed and relocated. Test new welds before activating new section.

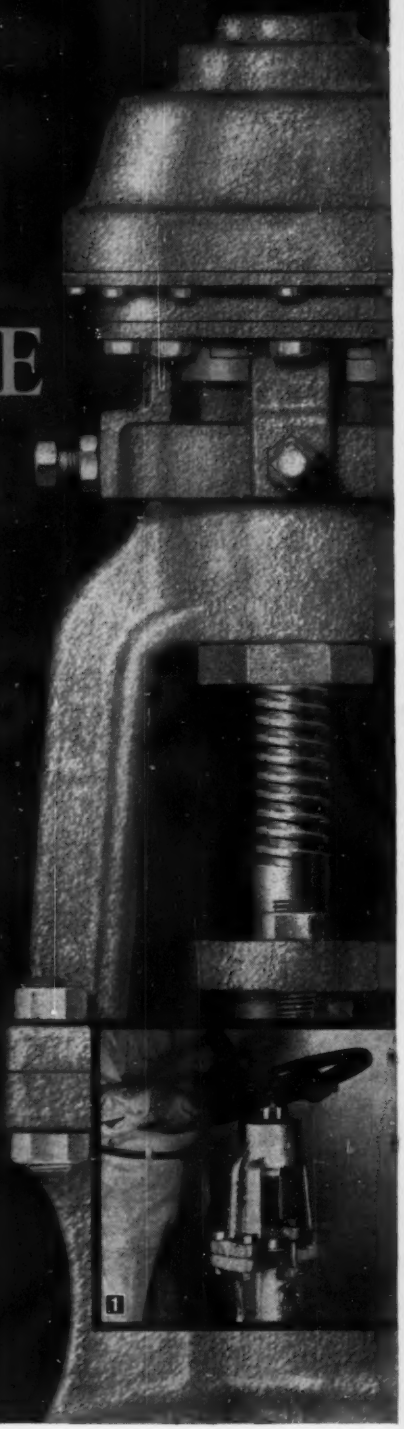
STEP 6 ACTIVATE MAIN

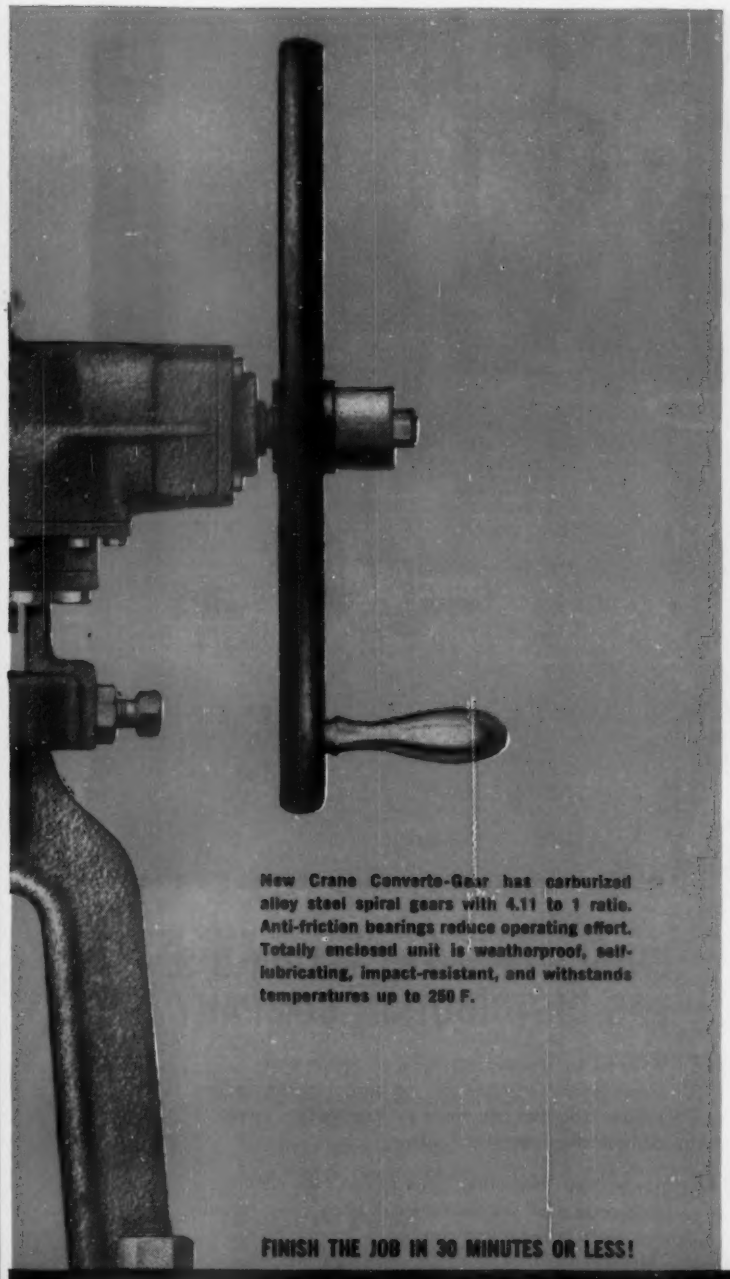
Purge isolated main section after welds have cooled. Using Unit #1 Stopping Machine, remove line stopper in downstream fitting and close gate valve. Then remove line stopper fitting in upstream fitting. Main section is now in operation. Remove by-pass. Plug and cap line stopper fittings and drilling nipples.

CRANE
DIRECTION '70

. . . a fast-moving program of planned expansion, product development, and streamlined distribution to help our customers meet the competitive challenges of the Sixties.

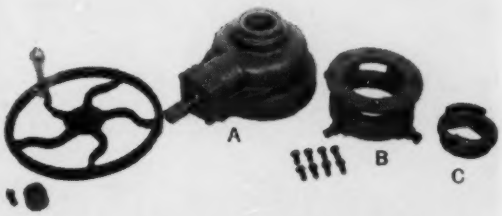
NEW! You can order this CRANE Converto-Gear Valve Operator from stock... install it in less than 30 minutes





New Crane Converto-Gear has carburized alloy steel spiral gears with 4.11 to 1 ratio. Anti-friction bearings reduce operating effort. Totally enclosed unit is weatherproof, self-lubricating, impact-resistant, and withstands temperatures up to 250 F.

FINISH THE JOB IN 30 MINUTES OR LESS!



Only three parts needed to convert your OS & Y valve to gear operation: (a) Crane Converto-Gear Operator, (b) adapter for mounting operator on valve, (c) yoke sleeve adapter. Handwheel and mounting bolts furnished with conversion kit.

Now you can convert to rapid, easy gear operation on many of your Crane iron and steel gate valves without removing them from the line! Changeover is simple and fast with Crane's new Converto-Gear Operator.

Your Crane Distributor can give you complete information on this brand-new idea in gear operators for gate valves. The Converto-Gear is standard and universal, readily mounted on Crane iron and steel gate valves in sizes from 6-inch to 36-inch, in outside screw and yoke or non-rising stem patterns.

And new orders for gear operated valves can be filled with unprecedented speed because the Converto-Gear can be supplied on valves right from stock. No special yoke castings or brackets are needed . . . just the basic gear operator and a simple two-piece adapter.

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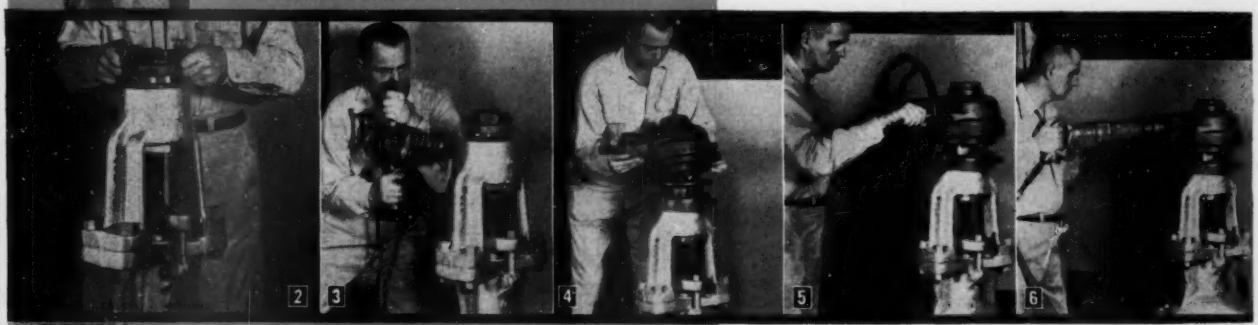
VALVES • ELECTRONIC CONTROLS • PIPING
PLUMBING • HEATING • AIR CONDITIONING



To convert your OS & Y valve, (1) remove the handwheel, (2) mount the yoke sleeve adapter, (3) countersink 4 holes for the Converto-Gear adapter, (4) bolt the adapter in place and attach your Crane Converto-Gear Operator, (5) and you're ready for smooth, manual operation, (6) or fast operation with an air or electric power operator.

CHOICE OF EVERY MAJOR U.S. GAS DISTRIBUTION COMPANY

DEPENDABLE Assured by unique simplicity of design and construction. Only one moving part, a tough, resilient rubber tube that can never stick or wedge, serves as both diaphragm and valve.

QUIET There is no "slamming". The rubber tube silently rolls on and off the slotted metal body core. Actually, the quietest valve you can use.

VERSATILE Use for pressure reducing, remote control operations, back pressure control, automatic shut-off and manual open-shut flow control. May be self operated or used with electrical, pneumatic or hydraulic actuated pilots. Can handle gas, water, most petroleum products. Available in sizes 1" to 12", working pressures to 1500 psi.

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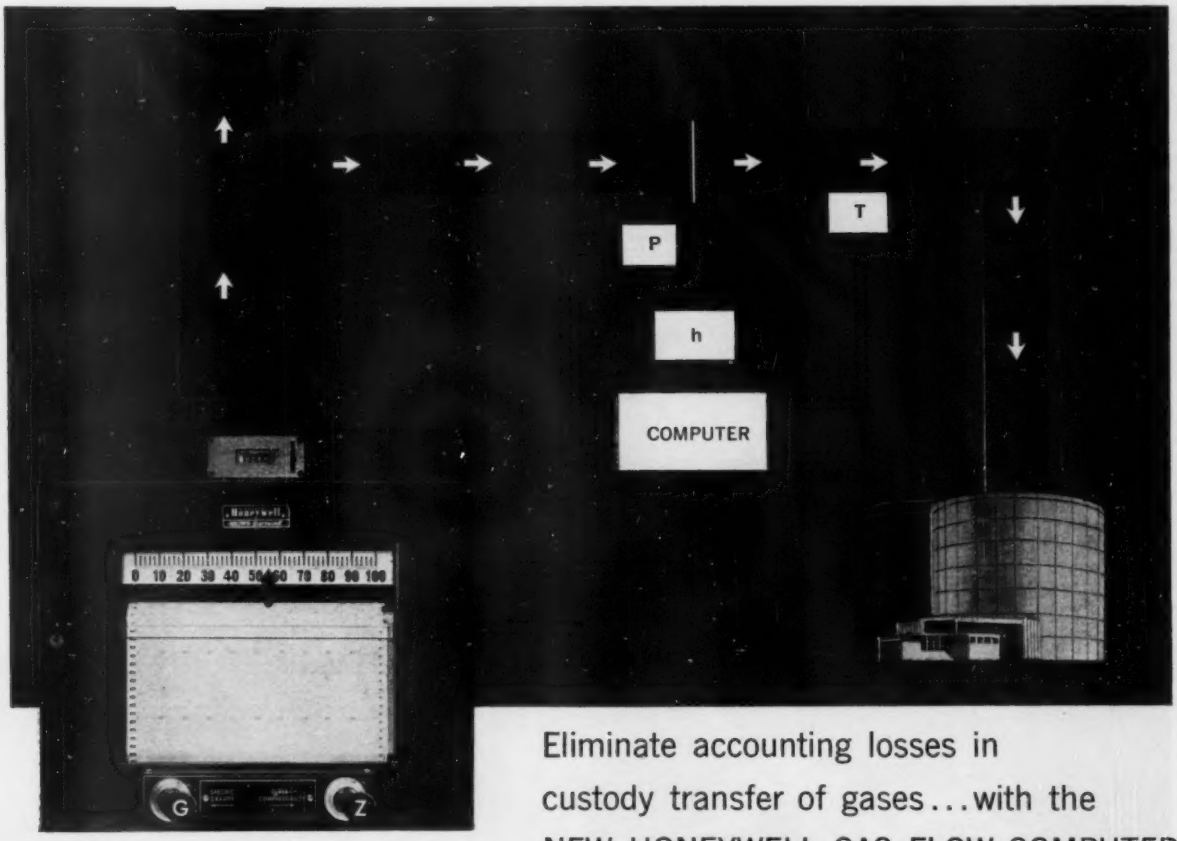


Eliminate accounting losses in custody transfer of gases...with the NEW HONEYWELL GAS FLOW COMPUTER

When you're selling or buying gas, even a slight inaccuracy in flow measurement can mean the loss of many dollars. Prevent this loss with the accurate, all-electric gas flow computer. It measures, records, and totalizes *mass rate* of gas flow, automatically and continuously. Temperature and pressure variations are compensated for automatically—eliminating the inaccuracies of "averaging" and other methods of computation.

The gas flow computer does away with tedious, time-consuming calculations and the possibility of human error. In most applications, it will perform with accuracy of $\pm 1\%$, and, under ideal conditions, with accuracy of $\pm \frac{1}{2}\%$. You can use this new computer to measure mass flow of natural gas, propane, butane and other hydrocarbons. And you can easily link it to telemetering and remote control systems, supervisory control, data handling, and industrial process computers. Cost of the computer in most installations runs less than $4000.

Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

Here's how the Honeywell gas flow computer solves a gas flow equation:

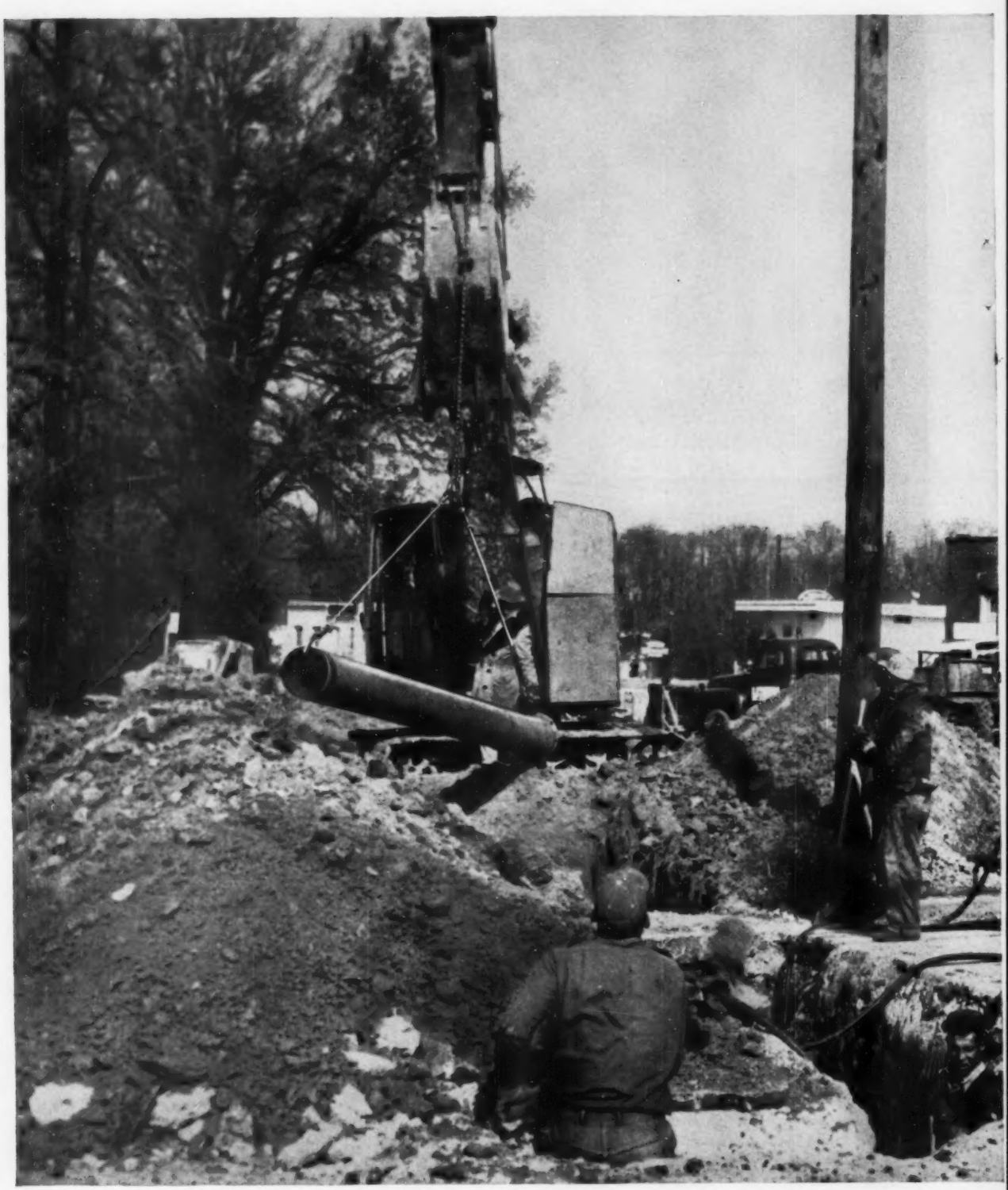
$$Q = K\sqrt{\frac{hP}{TGZ}}$$

Where **Q** = mass rate of flow, scfh
h = differential pressure, inches of water
P = static pressure, psia
T = flowing temperature, °R, (°F + 460)
G = specific gravity
Z = super-compressibility
K = orifice flow constant

The *ElectriK Tel-O-Set* △P/I transmitter measures *h*; an absolute pressure transducer measures *P*; and a resistance thermometer bulb measures *T*. The analog computer multiplies *h* by *P* and divides by *T* . . . and sends a resultant millivoltage to the *ElectroniK* recorder. The recorder applies the correction factors G and Z, extracts the square root, and records the resultant mass flow Q.

75th YEAR PIONEERING THE FUTURE

Honeywell
First in Control
SINCE 1885



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IF YOUR DECISION MUST STAND UP FOR 100 YEARS...

Will your decision today help determine your utility's gas system for the next century? Consider the case for cast iron pipe:

- Sixty-two American cities have had cast iron pipe gas mains in constant service for over a century.
- Rugged, corrosion-resistant cast iron pipe rarely needs repair once it's installed.
- Modern mechanical joints remain tight under normal distribution pressures.
- Cast iron pipe withstands all the usual stresses to which underground pipe is normally subjected.
- Easier to install—cast iron pipe comes in convenient lengths, ideal for congested underground installations.

Cast iron pipe's ruggedness . . . durability . . . and practically maintenance-free operation make for real savings over the years, too!

CAST IRON PIPE RESEARCH ASSOCIATION
Thos. F. Wolfe, Managing Director,
3440 Prudential Plaza, Chicago 1, Illinois

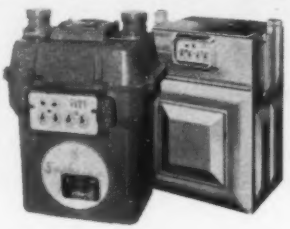
. . . good reasons for you to choose

CAST IRON PIPE

Superior is investing in *newness* to provide better products and better service to gas utilities. *New* products, *new* production methods, *new* research, and *new* organization... all represent Superior's commitment to grow in the years to come with the growing gas industry.

Superior meters have been performing dependably since 1912. Today, more than ever before they are your best buy for long-term accuracy and low-cost maintenance.

You can specify "Superior" with confidence. Nation-wide sales, service and warehousing facilities are available, now and in the future, to meet every utility metering need. When you buy "Superior" you, too, invest in progress.



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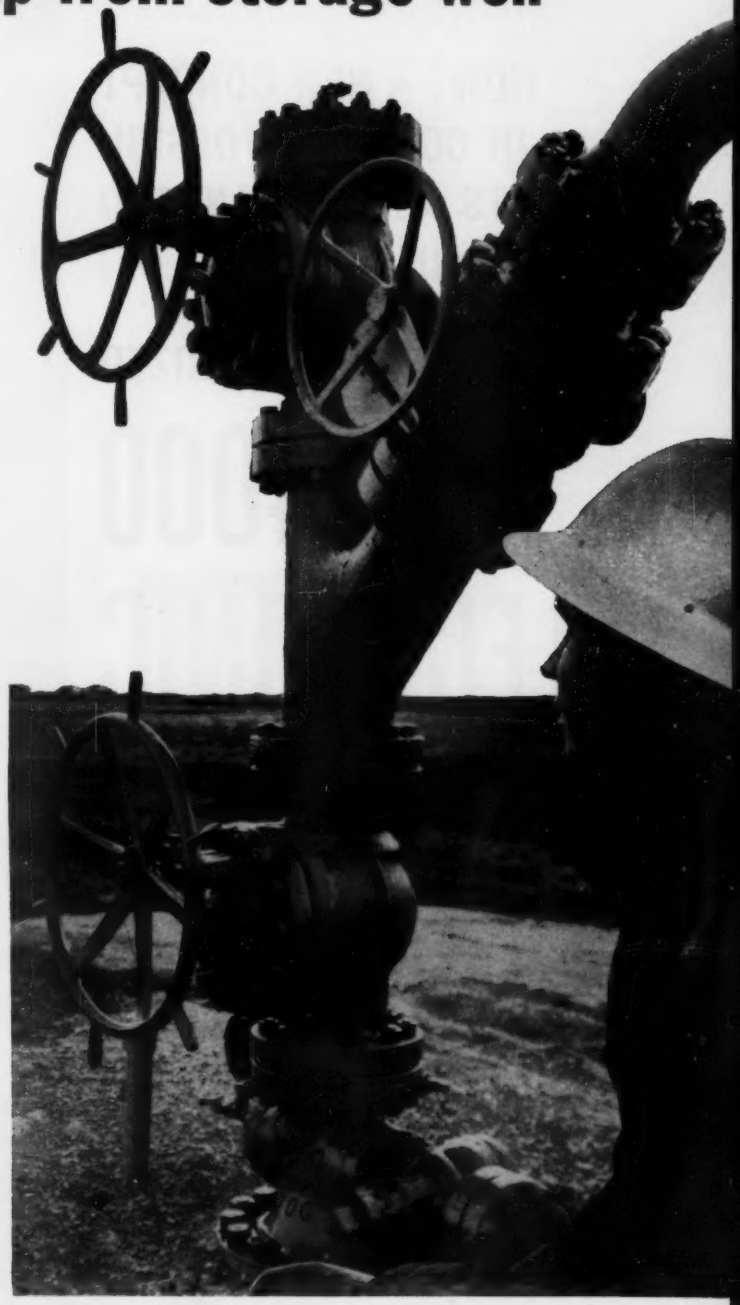
National Supply wellhead ends hydrate build-up from storage well

Northern Illinois Gas Company chose this National wellhead unit for several reasons: (1) The Y-design of flow manifolding makes the valve self-draining and prevents hydrate build-up in the long sweep; (2) The wellhead installation was simplified; (3) The pressure-packed design of the wellhead permits separation of slip and pressure loads, and also insures complete seal-off.

National Supply's experience with gas storage wellheads can help you, too. The process is very simple: we analyze the problems at your location; we define your wellhead needs and present the engineered solutions; we build the units for the particular wells.

National can design a wellhead assembly to handle virtually any special requirement. We have one of the world's largest varieties of quality components. The equipment conforms to API and AWHEM standards—and our testing pressures *exceed* API requirements. The many benefits of National Supply's wellhead design experience are readily available. Just send the coupon.



This National Supply unit was designed and built for a storage well of Northern Illinois Gas Company.

See the color film on world's first quintuple string producing well!

National Supply designed and assembled the history-making wellhead for this offshore gas well. A 20-minute color sound film showing this completion is available for group showings. If your group would like to see this film, please write to Sales Manager, Production Equipment, The National Supply Company, Pittsburgh 22, Pa.

THE NATIONAL SUPPLY COMPANY

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IN COMPUTER DESIGN
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THE FULLY-TRANSISTORIZED

RPC-4000 ELECTRONIC COMPUTING SYSTEM

The RPC-4000 is a new, fully-transistorized electronic computing system with the largest memory, greatest problem-solving capacity and flexibility in the low- or medium-priced field. It is the latest member of a growing family from the people whose LGP-30 has become the world's leading small-scale computer.

Wide range of applications: the RPC-4000 has been designed for engineering, scientific, business data processing and management control functions. Such jobs as product and process design, statistical analysis, research, inventory control, payroll and sales analysis are all well within its capabilities.

Easy to use: the RPC-4000 is simple to program and operate. Royal McBee compiling and translating routines allow even non-technical personnel to obtain maximum results. Versatile command structure gives programming speed and flexibility.

Available at low cost: high capacity, flexibility and ease of operation make the RPC-4000 the outstanding computer value on the market today.

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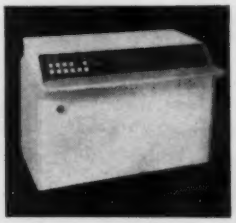
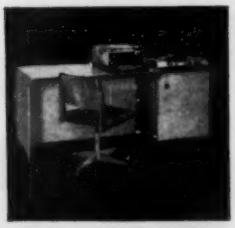
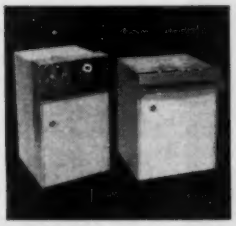
Continuing assistance: users benefit from free training, an information exchange service, and library of programs.



Heart of the RPC-4000 system is a new transistorized computer with advanced design concepts that provide substantial computing speed and capacity in a low-cost unit. Magnetic memory drum stores *8008 words*. Operating speeds are as high as 230,000/minute.



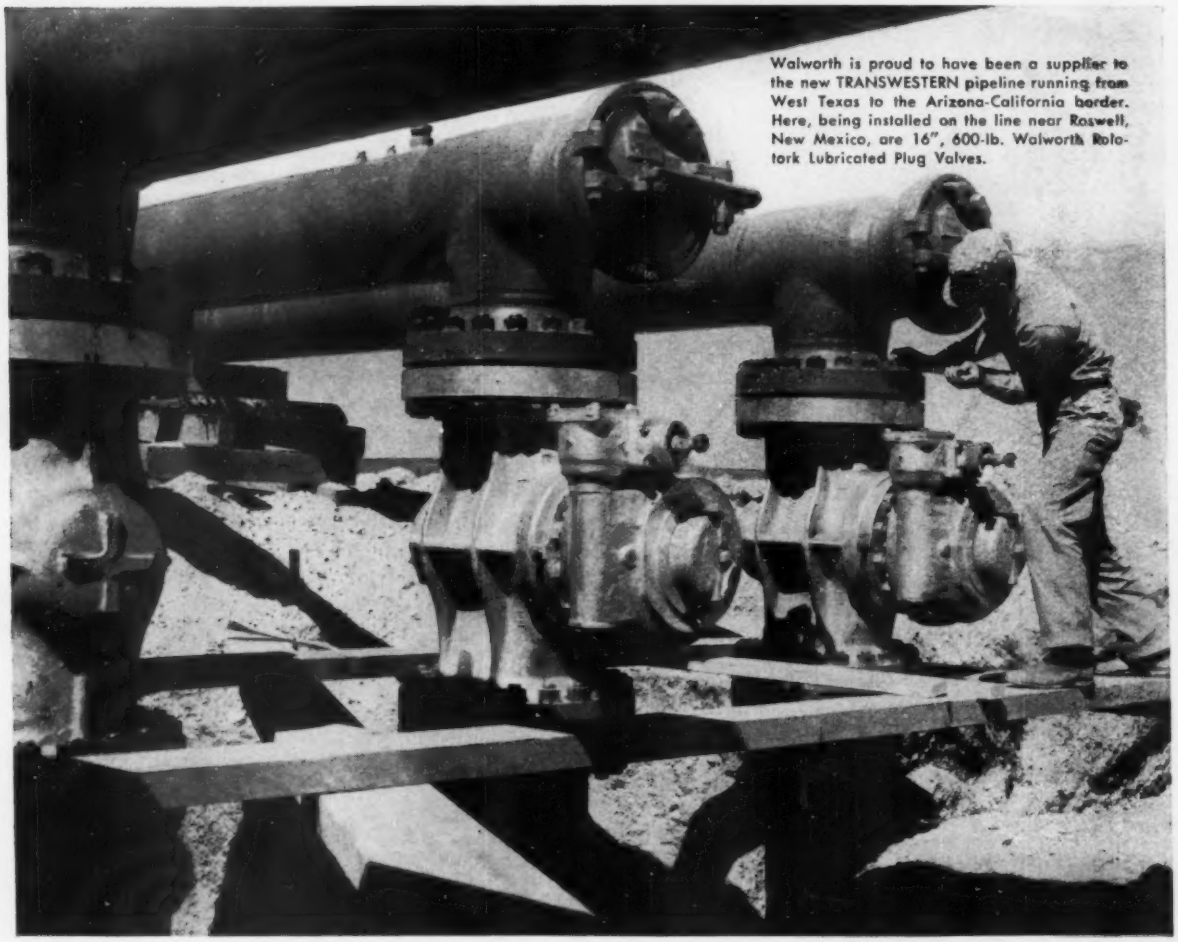
Standard input-output is a tape typewriter system which includes a Royal electric encoding-decoding typewriter complete with desk and chair, plus a tape punch-read console. Read speed is 60 characters/sec., punch speed 30 characters/sec. Typewriter, punch and reader may be interconnected in any combination for both on-line and off-line operations.



A new 500 character/sec. photoelectric tape reader and a 300 character/sec. punch are available as optional input-output equipment. A magnetic tape unit and a line printer will be available soon. As many as 17 input-output devices (60 with minor modification) may be connected on-line to the basic system. All peripheral equipment is under automatic program control of the computer.

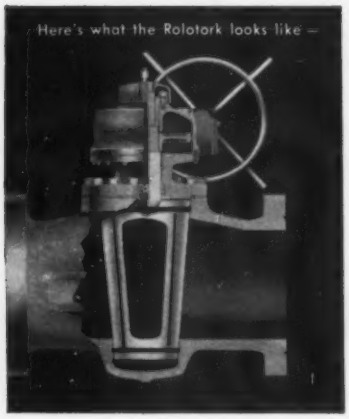
Royal Precision Corporation

Royal Precision is jointly owned by the Royal McBee and General Precision Equipment Corporations. RPC-4000 sales and service are available coast-to-coast, in Canada and abroad through Royal McBee Data Processing Offices. For full, detailed specifications on the new, transistorized RPC-4000, write **ROYAL McBEE** data processing division, Port Chester, N.Y.



Walworth is proud to have been a supplier to the new TRANSWESTERN pipeline running from West Texas to the Arizona-California border. Here, being installed on the line near Roswell, New Mexico, are 16", 600-lb. Walworth Rotork Lubricated Plug Valves.

RELY ON *ROLOTORK* ...BY WALWORTH



No matter what the service, you can rely on the Walworth Rolotork Lubricated Plug Valve to operate easily and dependably in handling gas, crude or finished petroleum products. In service throughout the world, these valves have proved their complete dependability. Why? Because Walworth manufactures a *better* LPV.

The Rolotork turns more easily, closes tighter, and requires less maintenance. It can be lubricated without removing the lubricant fitting. The gear housing design permits simple attachment of lubrication and handwheel extensions without modifying the gearcase. And vertical and circumferential lubricant grooves completely frame the port openings, preventing leakage.

These are just some of the features that make Walworth LPV's better. For additional information, write Department G-5.

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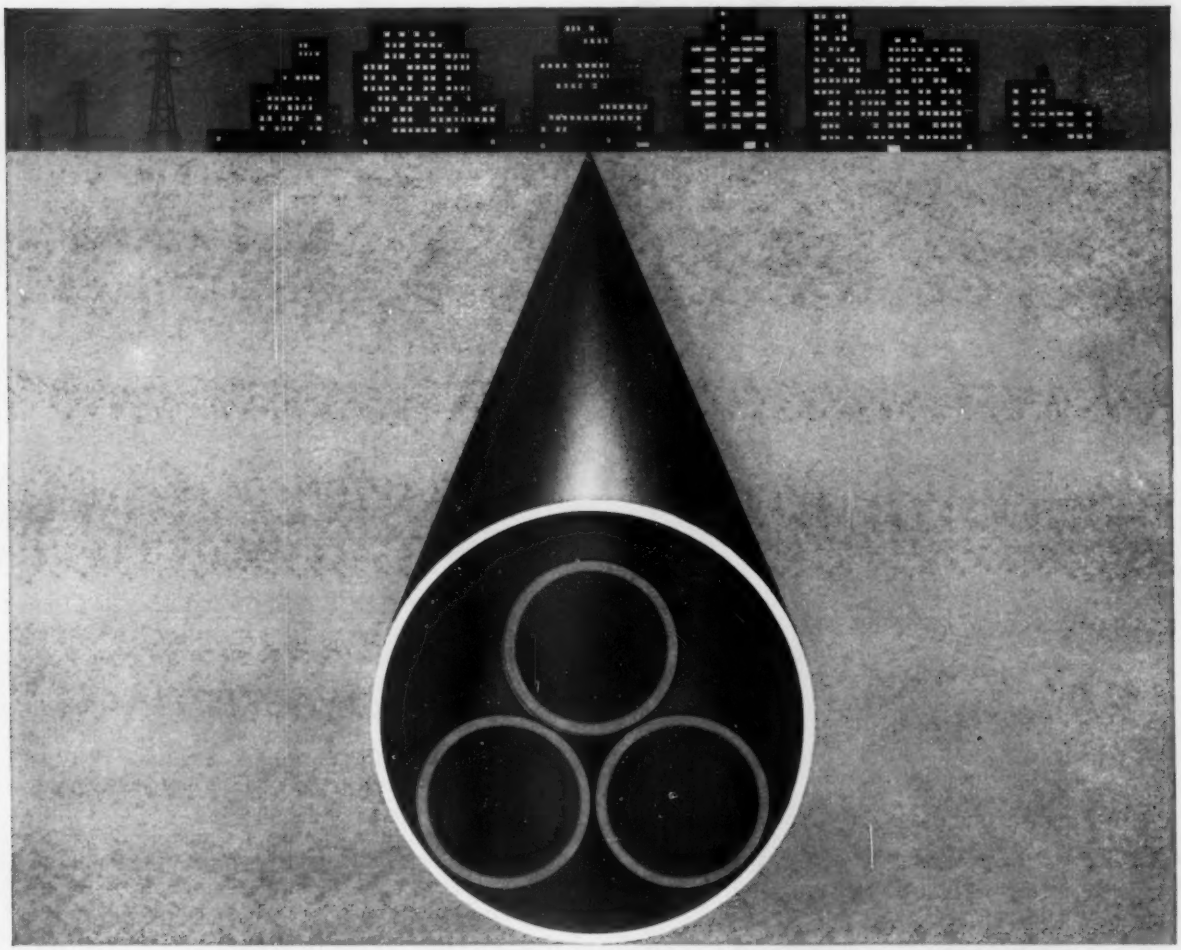

ALLIED CHEMICAL'S HOTLINE ENAMEL—LOW-COST, LASTING PROTECTION FOR HOT POWER LINES

Allied Chemical's Hotline Enamel provides oil-o-static lines without a rugged outer coating. It prevents corrosion that leads to oil leaks—a vital power line factor.

Proved on-the-job—Allied Chemical *Job-Matched* Hotline Enamel's protective coating shields against the damaging effects of soil stress, internal electrical heat, and the corrosive effects of water and soil chemicals. Proved in laboratory tests—a one year immersion in salt water solution revealed high resistivity whereas *all* asphalt enamels showed very low resistivity. Proved in company balance sheets—not only is Allied Chemicals Hotline Enamel's initial expense far below asphalt mastic, it also repays itself over the years with worry-free protection.

Provides improved protection under these conditions:

1. On pipe type cables or "oil-o-static lines" subject to internal electrical heat. (Up to 180° F. down to –10° F.).
2. Warm, swampy areas or other places where excessive soil stress is encountered.
3. Areas where backfill and trenches are rough, rocky or contain foreign objects which penetrate softer coatings.
4. Hot gas pipelines, on discharge side of compressor stations where line is above 120° F.
5. Pipelines (such as heated fuel lines) where temperatures are consistently high most of the time.

Field Service Experts are at your call for technical assistance that can save you maintenance time and costs.

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THE ANSWER TO CONNECTION PROBLEMS

BRANCH CONNECTIONS MADE UNDER PRESSURE

The best and most economical method of making lateral or branch connections is to use Smith All Mechanical Joint Tapping Sleeves and Valves or Stopper Pieces. This method ELIMINATES GAS SHUT OFF and the permanent, leak-proof installation is achieved speedily by employing these simple procedures: 1. Block Sleeve Outlet Half under pipe, position side flange gaskets, bolt Sleeve halves together. 2. Position end joint gaskets; install follower rings, bolts and nuts. 3. Rotate Sleeve outlet flange to desired position, tighten follower ring nuts. 4. Tighten side flange gasket compression screws. 5. Attach Tapping Valve. The installation is complete and ready for tapping. 5. (Alternate) Stopper Pieces may be used in place of Valves when connections are made to low pressure mains and permanent shut off Valves are not needed; however, the use of Tapping Valves is recommended. The cost of the connection is reduced by quicker installation, elimination of skilled labor and costly jointing material. Bulletin will be sent on request.

51

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THE A.P. SMITH MFG. CO.

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Why? Because through the years Empire has been the world's largest manufacturer of gas floor furnaces. The Empire gas floor furnace has been proven to be the *best made* by thousands of satisfied dealers and users. Why don't you be among them . . .

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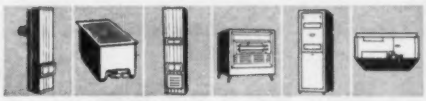

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Manufacturers of the finest complete line of Certified Gas heating appliances

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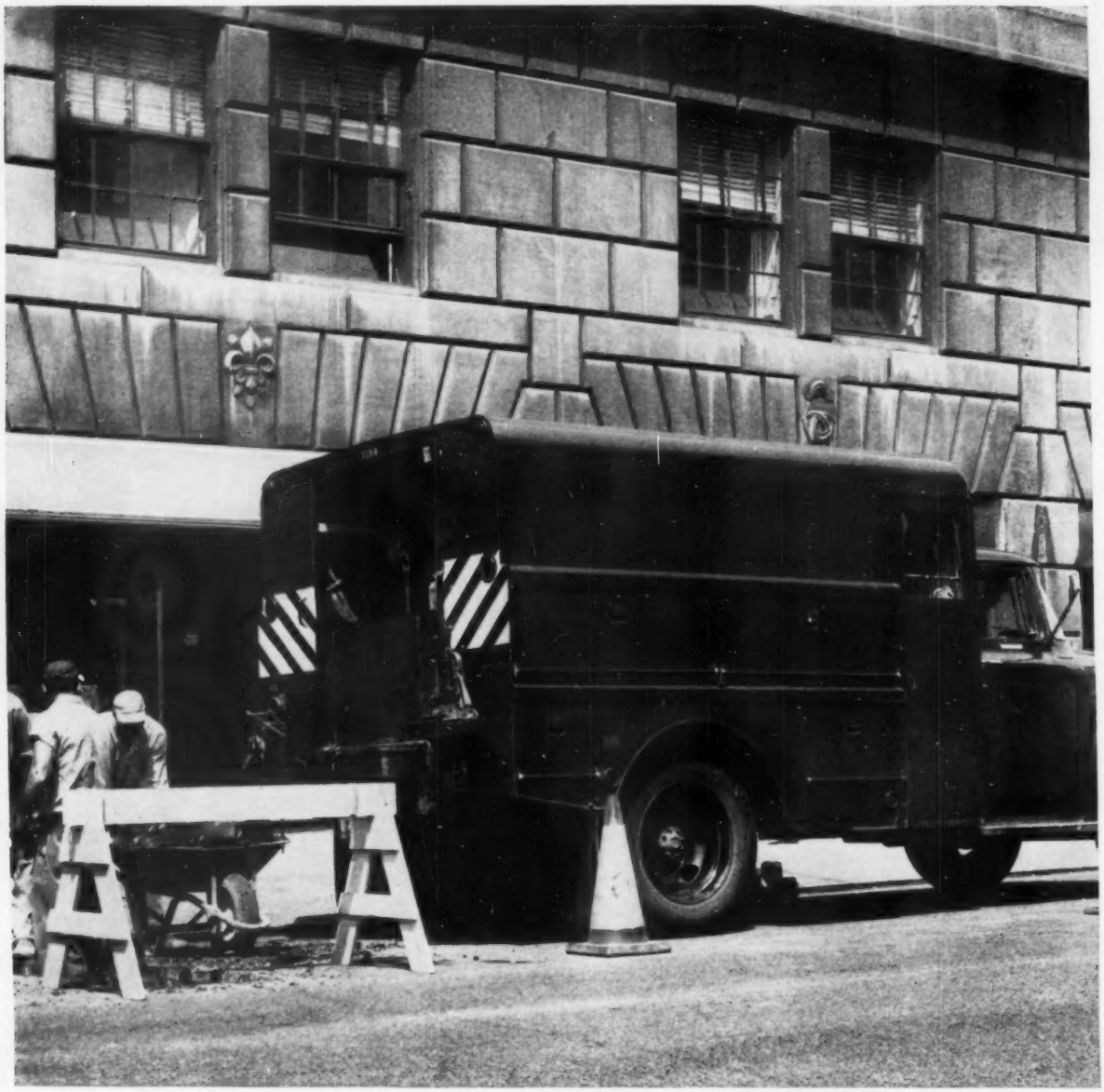

A HUSKY HOLAN BODY...

built for your gas construction work

Holan's Model 4154 Gas Construction body is big and husky—built specifically for gas construction and maintenance work.

A nine-man crew—four in the crew compartment, three in the cab and two on the hinged seat in the enclosed body—can ride to the work site in the 4154. Roomy compartments carry lanterns, barricade boards, tools and pipe fittings and three "through" compartments are provided for storage of bars, tamps and shovels. A left side pipe trough with front fender support will carry up to 4″ pipes.

The big, roomy 4154 is of all-welded, high tensile construction... your assurance of huskiness without unnecessary weight.

Write to us for complete details . . . or ask your Holan Field Representative about the Model 4154.

Holan Corporation, 4100 West 150th Street, Cleveland 35, Ohio
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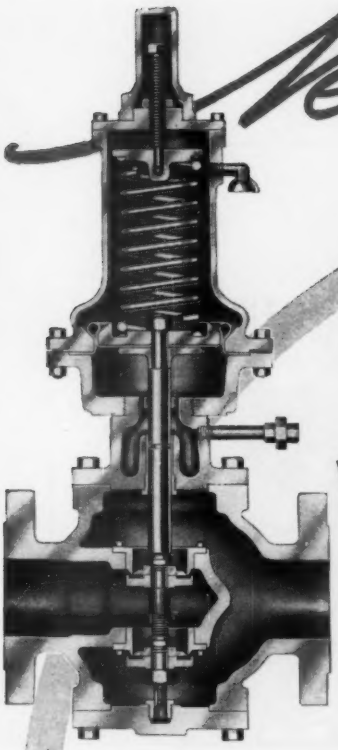
Holan

Subsidiary of THE OHIO BRASS COMPANY

HOLAN

New in principle!



CHAPLIN-FULTON

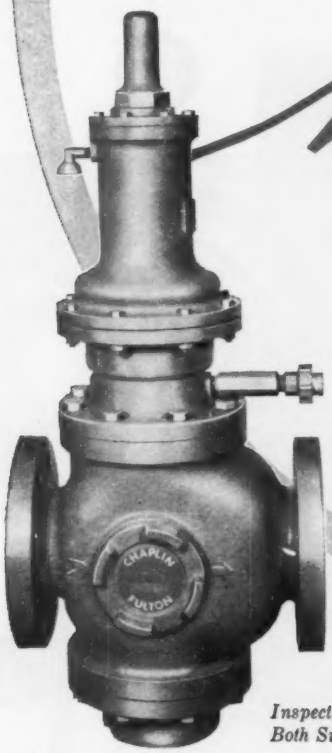
MODEL 441-57S

GAS REGULATOR

SIZE: 2"—3"—4"—6"
125 lb. iron—W. P. 175 psi
250 lb. ductile—W. P. 400 psi
Series 30 steel—W. P. 720 psi

Model 57-S, a simple spring loaded regulator, operates on a new diaphragm principle which will control accurately until the regulator is wide open. The outlet pressure "fall-off," typical of spring regulators, is eliminated—not by an uncontrolled velocity effect—but by a diaphragm which changes its size as the valve moves to give straight line control. For pounds-to-pounds service,—controlled pressures to 75 psi with same assembly.

New in design!



Inspection Plates Both Sides.

Also, a new body design—441—with gas exit areas greatly enlarged to prevent turbulence and increase capacity.
And to help in your visual inspection program—side inspection plates on *both* sides of the body have been included. Screwed-on with O-ring seal, they can be quickly removed and replaced—no gasket problem. Standard face-to-face dimensions now make the 441 interchangeable with other regulators.

ACCURATE CP MFG CO DEPENDABLE

Chaplin-Fulton
MANUFACTURING COMPANY
Pittsburgh 25, Pennsylvania

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NEXT STOP... BAY BOTTOM!

American Molox Ball Joint Pipe Specified for Gas Installation

"Our experience with underwater installations caused us to select Cast Iron Pipe . . . AMERICAN Molox Ball Joint pipe," says one distribution engineer for an outstanding West Coast gas utility. The above view shows workmen assembling 10" AMERICAN Molox Ball Joint pipe on board the construction barge, part of a 3,500-foot underwater gas supply line. The 96-foot sections were lowered with the aid of a strongback for assembly beneath the surface.

Specify rugged AMERICAN Molox Ball Joint pipe for river crossings and other difficult underwater installations. Molox pipe affords maximum installation economies because it is easily adapted to several installation methods: It can be floated or pulled across streams, or can be installed directly on the bottom from a barge. Once laid, it remains bottle-tight at any angle. The joint is designed for deflections up to 15°.

Before "plunging" into underwater pipe installations, consider these and many other advantages of AMERICAN Molox Ball Joint pipe. Write for free illustrated catalog.

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GAS

SEPTEMBER 1960

Engineering orifice meter installations

By GEORGE H. BOLTON JR.
Gas Engineering Dept.
Manufacturers Light & Heat Co., Pittsburgh

WHEN picking orifice plates for automatic meter installation have you ever mumbled "cotton pickin' plates" (or stronger words to that effect)?

Sometimes those closing differentials just don't come out right on the first go-round with a by-guess and by-gosh sizing procedure. What can be done to make selection of orifice plates for a multiple meter installation as simple as sizing a single plate?

Let's start by reviewing what happens in an automatic two-meter orifice measuring station. (See *Fig. 1.*)

Initially, at no flow, the meter run shut-off valve is closed and neither meter has a differential across it. As flow begins, the differential builds across the primary meter. When it reaches the opening differential of the meter run shut-off valve, the differential controller is alerted and opens the valve. As the valve

GAS exclusive

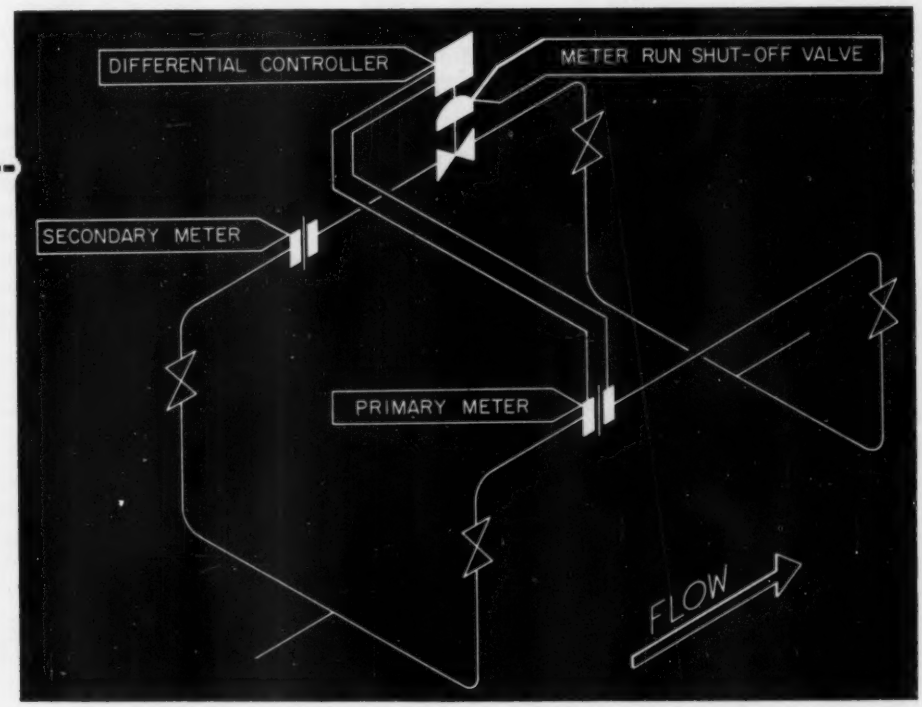

Fig. 1. Action in an automatic two-meter orifice measuring station.

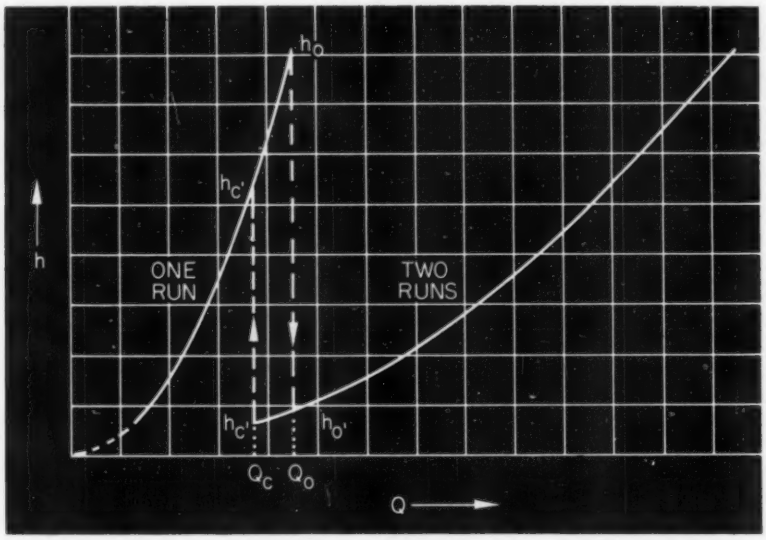

Fig. 2. Differential vs. flow at a constant pressure at a two-meter station.

opens, essentially the same flow is now going through both meters, so the differentials fall. As the flow continues to increase, so do the differentials across both meters.

For this development it may be assumed that when two runs are on, the differentials across both plates are the same. The differential across the station certainly would have but one value for one set of flow and pressure conditions, but even with two physically identical runs there would be a larger drop through the run passing a greater flow. Piping variations may accentuate or minimize this difference; however, it is not sufficient to disrupt this sizing procedure since the meters record the actual differential for measurement accuracy.

When the load recedes, the differentials fall until the closing point for the meter run shut-off valve is reached. At this point the shut-off valve is closed, the flow is forced to go through the primary run only, hence the differential across it jumps up. As the flow continues to decrease, the differential drops.

For a concise picture of this process, one may graph differential versus flow at a constant pressure (*Fig. 2*). The "one run" portion of the curve represents the situation with just the primary run in operation up to the opening differential (h_o) of the shut-off valve. The "two run" portion shows both runs operating down to the closing differential (h_c) of the shut-off valve. The dashed vertical lines show the operation of this valve.

Again, starting from no flow, as the flow increases, the differential, across the primary meter only, builds to the opening differential (h_o) of the shut-off valve. Let us denote the flow at this point by Q_o. Still at essentially this opening flow, the secondary run is put into operation and the differentials across both meters become h_o'. The differentials then increase with the load. As flow decreases to the closing flow (Q_c), the differentials drop to the closing differential (h_c). At this point the secondary run shuts off and the differential jumps to h_c' across the primary meter.

We note that the opening and closing flows are separated. This is to keep from confusing the differential controller. If the opening and closing flows were the same, and the load hovered in that vicinity, the differential controller would become frustrated and cycle, or pump, alternately turning the secondary run on and off. This would result in a miserable chart record to the consternation of the chart integrators. Wishing to preserve "peace in the family," we separate the opening and closing flows to get better operation and records.

But the differential controller is adjusted on differential, not flow. Now there arises a new problem; where and what should the separation in differential be? We may call this separation differential the pumping allowance, h_p. From *Fig. 2* it may be seen that for the same increase in flow (say from Q_c to Q_o), the differential will rise faster across the primary alone than across both meters when the two runs are on. We may prove this by transposing

$$Q = C\sqrt{hP}^*$$

to:

$$h = \frac{Q^2/P}{C^2}$$

Letting:

C_1 = Orifice constant, primary run

C_2 = Orifice constant, secondary run

And at constant static measuring pressure, P, Substituting in:

$$(h_o - h_c') > (h_o' - h_c)$$

We get:

$$\frac{Q_o^2/P}{C_1^2} - \frac{Q_c^2/P}{C_1^2} > \frac{Q_o^2/P}{(C_1 + C_2)^2} - \frac{Q_c^2/P}{(C_1 + C_2)^2}$$

* The basic orifice formula where: Q = Flow, C = Orifice constant, h = Differential pressure across the orifice, P = Static pressure.

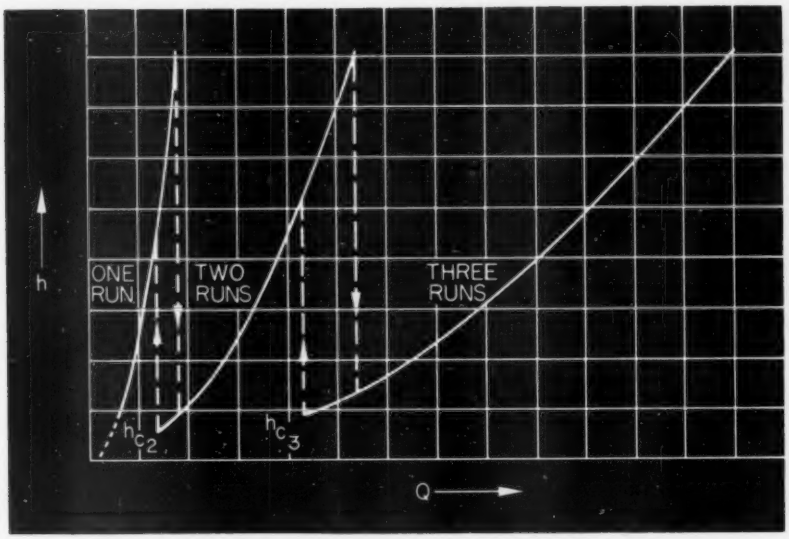

Fig. 3. Differential vs. flow at a three-meter station.

$$\frac{Q_o^2 - Q_c^2}{C_1^2} > \frac{Q_o^2 - Q_c^2}{(C_1 + C_2)^2}$$

$$\frac{1}{C_1^2} > \frac{1}{(C_1 + C_2)^2}$$

$$(C_1 + C_2)^2 > C_1^2$$

$$C_1^2 + 2C_1C_2 + C_2^2 > C_1^2$$

$$C_2^2 + 2C_1C_2 > 0 \qquad \text{Q.E.D.}$$

Therefore, if the pumping allowance separating h_c from h_o' is adequate, the separation between h_c' and h_o will be more than sufficient.

For our main objective, to arrive at some relation between the two orifice constants, let's look at the flow, Q_o, when the meter run shut-off valve opens. It may be expressed two ways:

1. With only the primary meter on at opening differential, h_o, and
2. With both the primary and secondary meters on at differential h_o'.

Then,

$$Q_o = C_1 \sqrt{h_o P}$$

And also,

$$Q_o = (C_1 + C_2) \sqrt{ho'P}$$

But,

$$Q_o = Q_o$$

Therefore,

$$C_1 \sqrt{h_o P} = (C_1 + C_2) \sqrt{h_o' P}$$

$$C_1 \sqrt{h_o} = (C_1 + C_2) \sqrt{h_o'}$$

But h_o' is the closing differential plus the pumping allowance, or,

$$h_o' = h_c + h_p$$

Hence,

$$C_1 \sqrt{h_o} = (C_1 + C_2) \sqrt{h_c + h_p} \qquad \text{(Equation A.)}$$

$$C_1 \left(\sqrt{h_o} - \sqrt{h_c + h_p}\right) = C_2 \sqrt{h_c + h_p}$$

Or,

$$C_1 = \left(\frac{\sqrt{h_c + h_p}}{\sqrt{h_o} - \sqrt{h_c + h_p}}\right) C_2$$

If we were using a 100-in. wc gauge and wished to limit the minimum differential to 6-in. wc, we would set the closing differential equal to this value, or h_c = 6-in. wc. Not wanting to over-range the gauge, we might select a maximum differential, the opening differential, of 81-in. wc, or h_o = 81-in. wc. But by how much should the pumping allowance separate h_c from h_o'? This may vary, but with a 100-in. wc gauge, 3-in. wc has been found generally adequate; h_p = 3-in. wc.

Then,

$$C_1 = \left(\frac{\sqrt{h_c + h_p}}{\sqrt{h_o} - \sqrt{h_c + h_p}}\right) C_2$$

$$C_1 = \left(\frac{\sqrt{6 + 3}}{\sqrt{81} - \sqrt{6 + 3}}\right) C_2$$

$$C_1 = \left(\frac{\sqrt{9}}{\sqrt{81} - \sqrt{9}}\right) C_2$$

$$= \left(\frac{3}{9 - 3}\right) C_2$$

$$= \frac{3}{6} C_2$$

Or,

$$C_1 = \frac{1}{2} C_2$$

Since one reason we turn to multiple meter stations is for increased rangeability, it is of interest to know what this rangeability (ratio of maximum flow to minimum flow) is. The maximum flow, Q_M, will occur with both runs on at maximum differential, h_M. The minimum flow, Q_m, will be that through

TABLE 1 SPECIFIC DESIGN FORMULAE

(Based upon a maximum and opening differential of 81 in. wc, a minimum differential of 6 in. wc, and a pumping allowance of 3 in. wc)

STATION RUNS	RANGEABILITY	ORIFICE CONSTANTS	CLOSING DIFFERENTIALS
1	3.67	$C_1 = 0.111\ Q_M/\sqrt{P}$	—
2	11.0	$C_2 = 0.0741\ Q_M/\sqrt{P}$	$h_c = 81\left(\frac{C_1}{C_1 + C_2}\right)^2 - 3$
		$C_1 = 0.500\ C_2$	
3	28.6	$C_3 = 0.0683\ Q_M/\sqrt{P}$	$h_{c_2} = 81\left(\frac{C_1}{C_1 + C_2}\right)^2 - 3$
		$C_2 = 0.417\ C_3$	
		$C_1 = 0.500\ C_2$	$h_{c_3} = 81\left(\frac{C_1 + C_2}{C_1 + C_2 + C_3}\right)^2 - 3$

the primary only at minimum differential, h_m. Denoting the rangeability as R,

$$R = \frac{Q_M}{Q_m} = \frac{(C_1 + C_2)\sqrt{h_M P}}{C_1\sqrt{h_m P}}$$

But,

$h_M = h_o = 81$ in. w c

$h_m = h_c = 6$ in. w c

And,

$$C_1 = \frac{1}{2} C_2$$

Or,

$$C_2 = 2C_1$$

Therefore,

$$R = \frac{(C_1 + 2C_1)\sqrt{81}}{C_1\sqrt{6}}$$

$$= \frac{3C_1}{C_1}\sqrt{\frac{81}{6}}$$

$$= 3\sqrt{13.5} = 3\ (3.67)$$

$$R = 11.0$$

Besides knowing the rangeability and the relationship between orifice constants, it is useful to know the secondary orifice constant as a function of the flow and pressure. From the rangeability development, the maximum flow is,

$$Q_M = (C_1 + C_2)\sqrt{h_M P}$$

But,

$$h_M = h_o$$

And,

$$C_1 = \frac{1}{2} C_2 = 0.5\ C_2$$

Therefore,

$$Q_M = (0.5\ C_2 + C_2)\sqrt{h_c P}$$

$$Q_M = 1.5\ C_2\sqrt{81P} = 9\ (1.5)\ C_2\sqrt{P}$$

$$Q_M = 13.5\ C_2\sqrt{P}$$

Or,

$$C_2 = (1/13.5)\ Q_M/\sqrt{P}$$

$$C_2 = 0.0741\ Q_M/\sqrt{P}$$

Using standard orifice plates one will probably never be able to find calculated and standard orifice constants in exact agreement, so it may be well to check the closing differential with the plates actually used. Returning to our development of the relation between C_1 and C_2,

$$C_1\sqrt{h_o} = (C_1 + C_2)\sqrt{h_c + h_p}$$

(Equation A.)

$$\sqrt{h_c + h_p} = \left(\frac{C_1}{C_1 + C_2}\right)\sqrt{h_o}$$

$$h_c + h_p = \left(\frac{C_1}{C_1 + C_2}\right)^2 h_o$$

$$h_c = h_o\left(\frac{C_1}{C_1 + C_2}\right)^2 - h_p$$

For the numerical values we have been using this becomes

$$h_c = 81\left(\frac{C_1}{C_1 + C_2}\right)^2 - 3,\ \text{in. wc}$$

Summarizing what we have developed concerning the two meter orifice stations, based upon an opening differential of 81-in. wc, a closing differential of 6-in. wc, and a pumping allowance of 3-in. wc:

Station Runs	Range-Ability	Orifice Constants	Closing Differential
2	11.0	$C_2 = 0.0741\ Q_M//P$	$h_c = 81$
		$C_1 = 0.500\ C_2$	$[C_1/(C_1 + C_2)]^2 - 3$

Let's try a hypothetical problem of sizing plates for an orifice metering station for a flow of 2.5-25 Mscfh at a minimum pressure of 85 psig.

- **How many runs?**

The ratio of maximum to minimum flows is 25/2.5 = 10. This is less than 11.0, so two runs are adequate.

- **What size runs and orifices?**

These may be determined by selecting the smallest run size with a constant at least as large as the maximum required, C_2.

$C_2 = 0.0741\ Q_M/\sqrt{P}$

$Q_M = 25$ mscfh

$P = 85 + 15 = 100$ psia

$\sqrt{P} = 10$

$C_2 = (0.0741)\ 25{,}000/10$

$C_2 = 185$

Referring to a table of orifice constants we might find for 0.6 specific gravity natural gas:

Orifice Diameter (Inches)	Run Size (Nominal Diameter) 2 in.	4 in.	6 in.
0.375	36.7		
0.500	65.3		
0.625	102		
0.750	149		
0.875	205		
1.000	271	263	261

From this we note a 2-in. run is adequate. Selecting the orifice with a constant closest to 185, we choose 0.875 in. x 2 in. with a constant of 205. To obtain the desired closing differential we must preserve the proper proportions between C_1 and C_2.

Hence we use $C_1 = \frac{1}{2}C_2$ where C_2 is the *actual* secondary plate constant.

$C_1 = \frac{1}{2}\ (205) = 102$

For the primary run select a 0.625 plate with a constant of 102.

Check the closing differential

$h_c = 81\ [C_1/(C_1 + C_2)]^2 - 3$

$= 81\ [102/(102 + 205)]^2 - 3$

$= 81\ (0.332)^2 - 3 = 81\ (0.110) - 3 = 9 - 3$

$h_c = 6$ in. wc Okay

Check the maximum flow

$Q_M = (C_1 + C_2)\sqrt{h_o P}$

$= (102 + 205)\sqrt{81}\sqrt{100}$

$= 307\ (9)\ 10 = 27{,}630$

$Q_M = 27.6$ Mscfh > 25 Mscfh Okay

Check the minimum flow

$Q_m = C_1\sqrt{h_c P}$

$= 102\sqrt{6}\sqrt{100}$

$= 102\ (2.45)\ 10 = 2{,}499$

$Q_m = 2.5$ Mscfh $= 2.5$ Mscfh Okay

Meter specifications

Primary Orifice = 0.625 in. x 2 in.
Secondary Orifice = 0.875 in. x 2 in.
Closing Differential = 6 in. wc
Opening Differential = 81 in. wc

If you're temporarily saturated with math, now's a good time for a coffee break.

All set? Here we go again. Using the foregoing

TABLE 3. SYMBOLS

- Q = Flow, standard cubic feet per hour, scfh
- Q_M = Maximum flow, scfh
- Q_m = Minimum flow, scfh
- P = Static measuring pressure, psia
- C_1 = Orifice constant, primary meter
- C_2 = Orifice constant, secondary meter
- C_3 = Orifice constant, tertiary meter
- h_c = Closing differential, inches water column (in.wc)
- h_{c2} = Closing differential, in.wc, secondary of three runs
- h_{c3} = Closing differential, in.wc, tertiary of three runs
- h_o = Opening differential, in.wc
- h_p = Pumping allowance, in.wc

TABLE 2 GENERAL DESIGN FORMULAE

STATION RUNS	RANGEABILITY	ORIFICE CONSTANTS	CLOSING DIFFERENTIALS
1	$\sqrt{h_o/h_c}$	$C_1 = \left(\frac{1}{\sqrt{h_o}}\right) Q_M/\sqrt{P}$	—
2	$h_o/\sqrt{h_c\,(h_c + h_p)}$	$C_2 = \left(\frac{\sqrt{h_o} - \sqrt{h_c + h_p}}{h_o}\right) Q_M/\sqrt{P}$	$h_c = h_o\left(\frac{C_1}{C_1 + C_2}\right)^2 - h_p$
		$C_1 = \left(\frac{\sqrt{h_c + h_p}}{\sqrt{h_o} - \sqrt{h_c + h_p}}\right) C_2$	
3	$\frac{h_o\sqrt{h_o}}{\sqrt{h_c\,(h_c + h_p)\,(h_c + 2h_p)}}$	$C_2 = \left(\frac{\sqrt{h_o} - \sqrt{h_c + 2h_p}}{h_o}\right) Q_M/\sqrt{P}$	$h_{c_2} = h_o\left(\frac{C_1}{C_1 + C_2}\right)^2 - h_p$
		$C_2 = \left[\frac{\sqrt{h_c + 2h_p}\,(\sqrt{h_o} - \sqrt{h_c + h_p})}{h_o - \sqrt{h_o\,(h_c + 2h_p)}}\right] C_3$	$h_{c_3} = h_o\left(\frac{C_1 + C_2}{C_1 + C_2 + C_3}\right)^2 -$
		$C_1 = \left(\frac{\sqrt{h_c + h_p}}{\sqrt{h_o} - \sqrt{h_c + h_p}}\right) C_2$	

procedure one may extend this development for any number of runs. The only point of caution is to be aware that the closing points must increase for successive runs. For example, in a three-meter installation with three meters in operation and a decreasing flow, the tertiary run must have a higher closing differential than the secondary run so it will close first. This separation between closing points may be the pumping allowance. For a graphic look, see *Fig. 3.* Where:

h_{c2} = Secondary run closing differential

h_{c3} = Tertiary run closing differential

Table 1 summarizes information for one, two, and three-meter stations.

Maybe by now you are thinking, "Fine, but we usually use 200-in. gauges, measurement likes a minimum differential of at least 15 in., and we need 5 in. for pumping allowance." If that's the case, use the general formulae in *Table 2*, substitute values peculiar to your operations, and make the table most useful for you.

And if by now you've forgotten what some of those subscripts mean, *Table 3* is a list of symbols.

We may take still another step and calculate the maximum total orifice constant for a three-meter station on automatic operation. From the "Specific Design Formulae,"

$$C_2 = 0.417\ C_3$$

And

$$C_1 = 0.500\ C_2$$

Or,

$$C_1 = (0.500)\ (0.417\ C_3)$$

Therefore, the total constant, C_T, is:

$$C_T = C_1 + C_2 + C_3$$
$$= (0.500)\ (0.417)\ C_3 + (0.500)\ C_3 + C_3$$
$$= .208\ C_3 + .500\ C_3 + C_3$$
$$= 1.708\ C_3$$
$$C_T = 1.7\ C_3$$

And we may tabulate this station constant for some common run sizes.

Run Diameter, Nominal Inches	Maximum Plate Size, Inches	Maximum Constant, C_3	Station Constant, C_T
2	1.375	561	950
4	2.750	2,260	3,800
6	4.250	5,460	9,300
8	5.500	9,000	15,000
10	7.000	14,000	24,000
12	8.500	21,800	37,000

From this we may plot flow versus pressure at maximum differential (81-in. wc) and get results shown in *Fig. 4.*

Was it worth all this? Sure. If your boss, like mine, likes to ask, "Can we get 300,000 through a 4-in. station at 100 lb?" there is no frantic slip stick slipping and pencil pushing. A glance at the graph lets you answer quickly and confidently, "Yes," while barely interrupting Howard's story about the sports-minded engineer we just hired who thought a meter run was a rather short race. ■

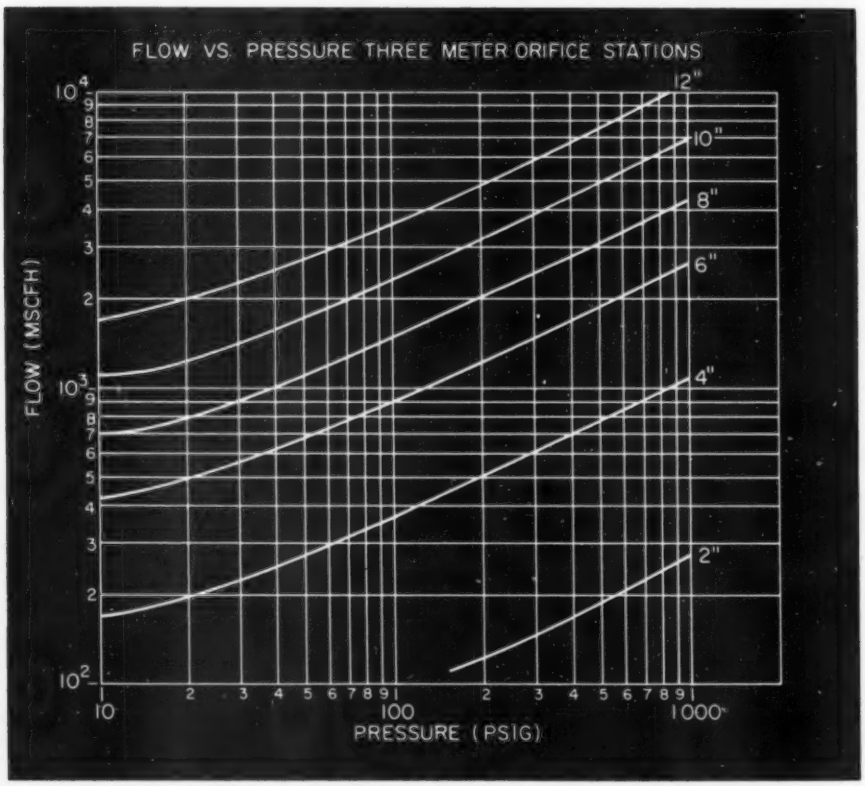

Fig. 4. Flow vs. pressure at maximum differential at a three-meter station.

A look at ethane liquefaction

By IRVING DEUTSCH, P.E.

GAS exclusive

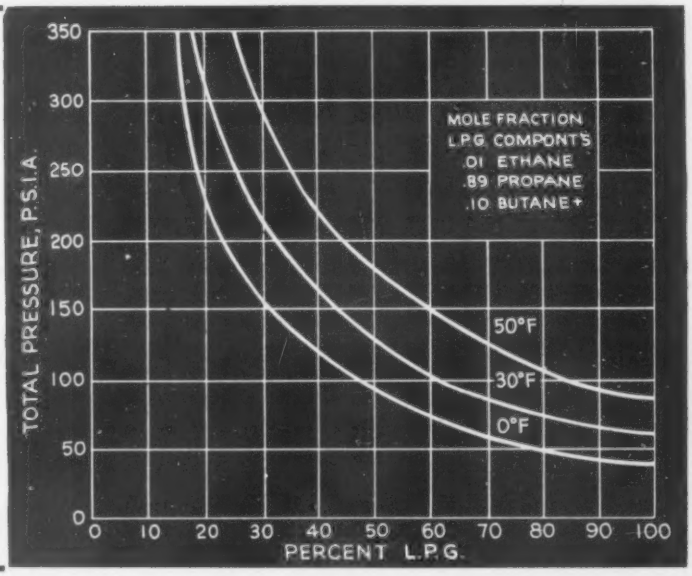

Fig. 1. Condensate boundary conditions for: % LPG in LPG-air mixture.

MUCH has been said and written regarding the peak shaving problem caused by the rapid growth of the gas heating load.

It is not my intent to thoroughly discuss all the problems of cost differentials or operating aspects of the compromise methods of meeting high peaks through the use of LPG-Air or methane liquefaction. Rather, I intend to discuss briefly the possibilities of the use of ethane stored for peak shaving use.

Strangely enough, in the search for an acceptable substitute for natural gas for peak shaving, we find in available literature the consideration of methane, propane and sometimes butane with the occasional reference to a methane-ethane-air mixture, but no reference to ethane and ethane-air.

In any serious search for a substitute for natural gas, essentially methane, C_1, it appears technically improper to pass directly to C_3, propane, completely overlooking C_2, ethane. It seems reasonable that ethane-air should be more compatible than propane-air with natural gas because its characteristics are closer to natural gas.

A brief cursory laboratory study of the compatibility of a 1020 Btu pure grade ethane-air mixture with 1020 Btu natural gas (94 per cent methane, 3.5 per cent ethane) using both the needle pilot and flashback pilot, shows that the ethane-air was practically indistinguishable from natural gas on ignition and combustion.

In the case of natural gas at even the lowest operating temperatures, the critical temperature is not reached; hence, the problem of condensation never occurs. *Fig. 1* shows that in the case of LPG-air, condensation is a real problem at about 90 psig pressure and 0 deg F. In the case of ethane-air, though operating temperatures are below the critical, the allowable pressure for 0 deg F is 400 psig. This is considerably above the normal operating pressures in a distribution system.

The Keesom Cascade System for the liquefaction of methane in natural gas, illustrated schematically in *Fig. 2*, will serve to show the reduction in equipment of an ethane liquefaction plant versus a methane liquefaction plant. To liquefy methane, three compressors, two interchangers and two condensers would be required. Only two compressors, one interchanger and one condenser would be needed for the ethane liquefaction plant. Other liquefaction schemes are possible such as the Claude and Heyland Systems, but it is not the object of this article to go into the details of liquefaction. The one step eliminated in the liquefaction of ethane as compared to methane is an advantage.

Over and above the fact that methane must be cooled to minus 260 deg F and ethane only to minus 140 deg F, is the fact that the specific heats at both constant pressure and temperature are respectively 22 and 12 per cent lower than methane. The 78 per cent greater heating value of ethane compensates for the greater cu ft of vapor per cu ft of liquid of methane as compared to ethane. The storage capacity of methane is 626 cu ft gas/cu ft liquid as compared to 440 ft ^{3}/ft for ethane. But taking heating value into account the storage capacity of ethane becomes 788 ft^3 gas/ft^3 liquid representing a 25 per cent increase in storage capacity for ethane as compared to methane.

Another possible saving in ethane liquefaction is that the cost of vaporization is reduced because of the accumulated reduced number of pounds to be liquefied at lower specific heats and less temperature differential between the liquid storage temperature and send-out temperature.

The liquid ethane system has the same characteristic as the liquid methane system in that the vapor pressure of ethane at 0 deg F is 200 psi, hence a 1000 Btu ethane-air gas can be sent out at roughly 400 psi.

There is no doubt that storage of both methane and ethane liquefaction is safe with properly designed tanks and diking.

Cryogenics in general and cryogenic metallurgy have taken many forward steps since the need for liquid oxygen for rockets.

The availability, operating and capital cost, and fixed charges for ethane must be considered for individual systems since there is little reference material to draw from.

Following are some possible sources of ethane that should be considered though at this stage it is unlikely that they are the only sources or even the best sources.

• Ethane from natural gas

The ideal solution to the production of ethane would be to use the low cost incoming natural gas and convert to ethane. This, unfortunately, could be a difficult problem since the equilibrium constant for the reaction:

$$C + 3\,CH_4 \rightarrow 2\,C_2H_6$$

is: $$K = \frac{(C_2H_6)^2}{(CH_4)^3} = 5 \times 10^{-9} \text{ at } 1400^\circ \text{ F.}$$

This is very low. Even at increased pressures, say 100 atmospheres, the mixture would contain less than 1 per cent. Despite this, it is not beyond imagination to consider an indirect approach using polymer gasoline reactions as reported in "Polymer Gasoline" by Gustav Egloff,* where the gases are heated to 450 deg F under a pressure of 2000 psi using a solid phosphoric acid catalyst. The process should be considerably advanced by this time. From the work of Alvin S. Gordon of the Bureau of Mines,** it is stated, "It was thought possible that acetylene attacked methane directly, yielding ethylene and a methylene radical. The methylene reacted with methane to form ethane, which decomposed to ethylene and then acetylene, setting up a chain reaction." Considering also the standard calcium carbide acetylene process, using coke and lime, it is not inconceivable that with the proper catalyst, retention time, temperature and pressure, a conversion of methane to ethane could be achieved.

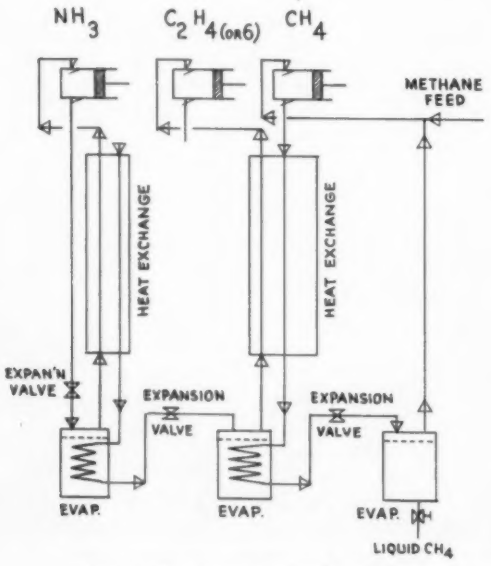

Fig. 2. The Keesom cascade system.

• Ethane extraction

Natural gas as received by distribution companies contains ethane. The difficulty that arises here is that all the gas must be processed in order to get sufficient quantities of ethane, hence the extraction should take place at the gate station. The ethane would have to be transferred to storage by truck or barge unless the gate station can be located near the storage area.

• Extraction at source

A further possibility is the purchase of liquid ethane, shipping the ethane by barge in the same manner that methane is now being shipped to London. Only storage facilities would then be necessary.

It is clear that ethane extraction holds some interesting possibilities and should be examined. At 1 cent per pound an Mcf of ethane will be about 85 cents and an Mcf of ethane-air at 1000 Btu about 50 cents.

The production of ethane from higher paraffins such as butane and distillate stock such as C_6 - C_7 hydrocarbon, gas oil, etc. suffers from the high cost of feedstock. It would offer little advantage over making an interchangeable methane-ethane gas by available well developed methods and storing the distillate stock until needed in low cost atmospheric pressure containers.

If the predictions on future loads hold true then in 10 or 20 years the gas distribution companies might welcome a gas with a higher $H/\sqrt{d}$ value. Methane or natural gas has a $H/\sqrt{d}$ value of 1000/.78 or 1280 but ethane having a heating value of 1786 Btu/ft^3 and a specific gravity of 1.05 hence a $H/\sqrt{d}$ value of 1700 or a 33 per cent increase in heat transmission capacity over methane.

• Summary

The liquefaction of ethane should be studied as a compromise between methane and propane. The physical characteristics of ethane as compared to methane indicate that ethane might be more economical to liquefy from both the capital investment cost and operating cost point of view. The condensation characteristics of ethane-air would permit much higher distribution pressures than propane-air. Extensive research might develop an economical method of converting methane to ethane, but ethane extraction equipment is commercially available now. ■

* Ind. Engr. Chem. 28, 1461 (1936).

** Ind. and Engr. Chem., Vol. 70, January 1948.

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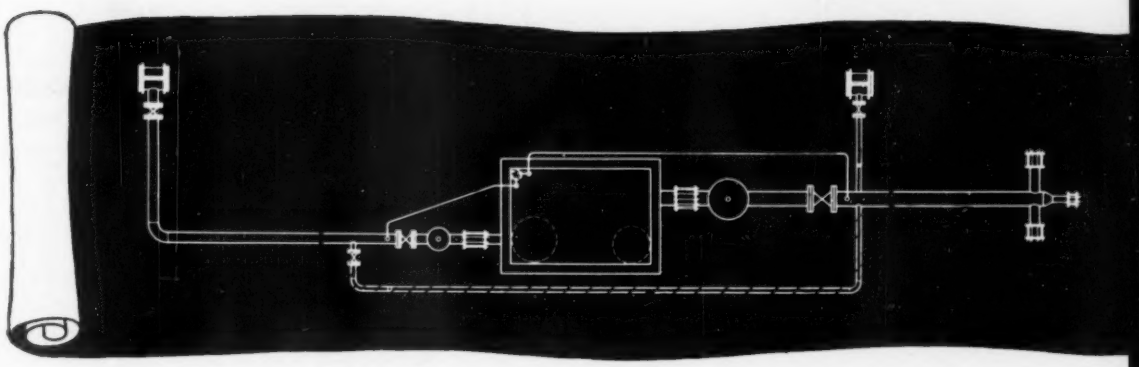
Distribution regulator station design



By E. A. SKIBINSKI, Engineer
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A well designed regulator station is like the perfect wife. She must be able to handle an unstable beginning and translate it into a smooth ending. She draws from available assets and distributes whatever there is, large or small, in fair and equitable quantities. She rarely blows off "steam," and when she does, her return to normalcy is almost immediate.

The Rochester system is operated at three general pressure levels. First we have a high pressure system made up almost entirely of transmission or supply lines operating at a maximum pressure of 125 psig. The relatively few services taken off the high pressure lines have outside field regulators and relief valves installed ahead of the service regulator and mercury seal in the building.

Our medium pressure system operates at pressures from two to 50 psig. The third system is low pressure, and operates at pressures below 12-in. W.C. The regulators supplying both of these systems are installed in underground vaults. Most of our district regulators are housed in underground vaults because of the difficulty of obtaining property for above ground stations. This discussion is confined to the underground vault type of station.

Ten years ago the acceptable district regulator design consisted of something like this:

(*a*) *Inside the vault* (*refer to Fig. 1*). Equipment and material consisted of a balanced valve regulator, weight and lever arm for high pressure, and outside weight loaded for low pressure stations. There were also the inlet and outlet valves, a compression coupling, and small piping for control and gauge lines.

(*b*) *The vault proper* was made of a 6-in. concrete floor, 8-in. concrete block walls, a roof composed of 70- and 80-lb railroad car rails, and two manhole frames with covers. All voids were filled with 6-in. concrete mix. Permanent type steel ladder rungs were installed on one wall.

(*c*) *Outside the vault* (*refer to Fig. 2*). Single 4-in. vent and gauge lines were provided and piped to a nearby gauge box mounted on a standard. The station bypass was outside the vault, usually one-half the size of the inlet piping. Control lines were normally extended outside the vault.

It is fairly obvious that this type of station was designed heavily for attack from the outside, not from within. The idea here was to be able to take the impact load of a large transport truck in case it ran off the road. This type of station was composed of two separated regulator vaults where the operating pressures were in the range of 15 to 50 psig for reduction to below 12-in. w.c. (*See Fig. 3*). Two sets of regulators operated in series for over-pressure protection. This was considered a good safe method at the time. However the design became obsolete and since 1952 every regulator vault in the Rochester system has been rebuilt to improved standards.

All new vaults have been constructed in accordance with an advanced design meeting all requirements of

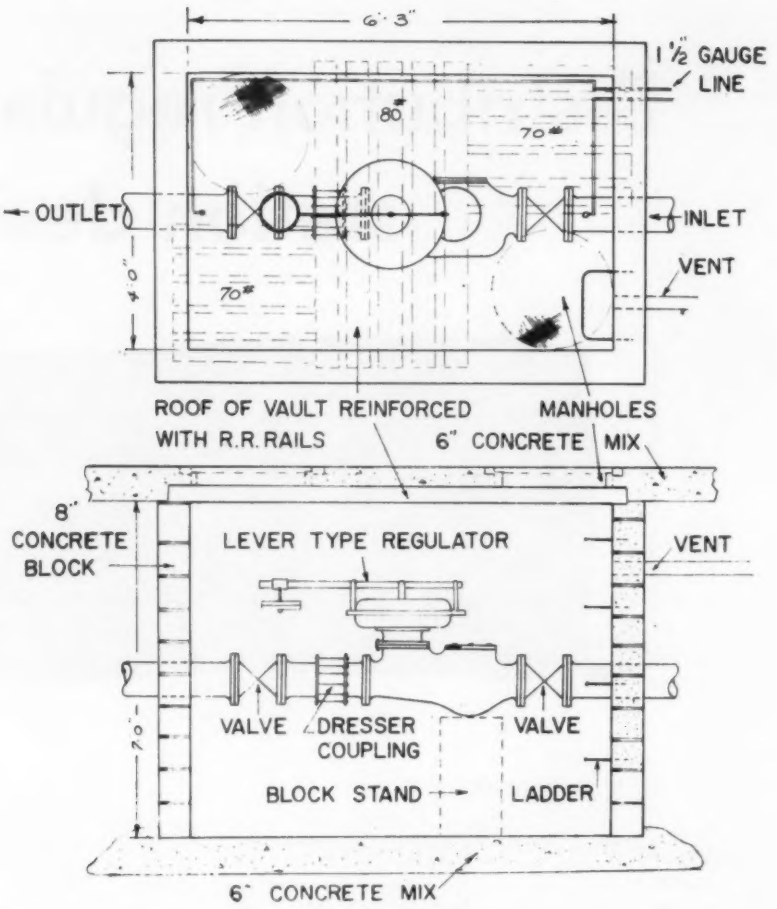


Fig. 1. Detail of old type regulator and vault.

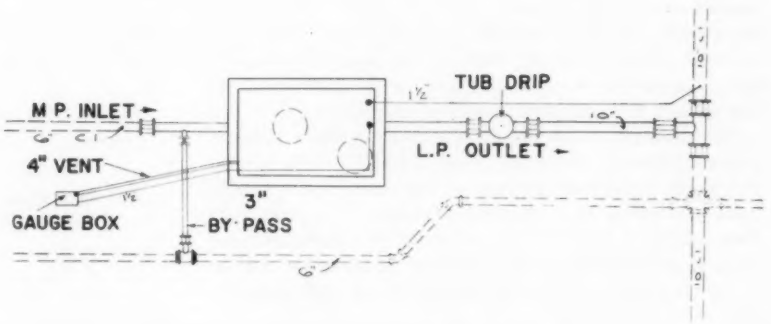


Fig. 2. Typical single district regulator layout, 1950.

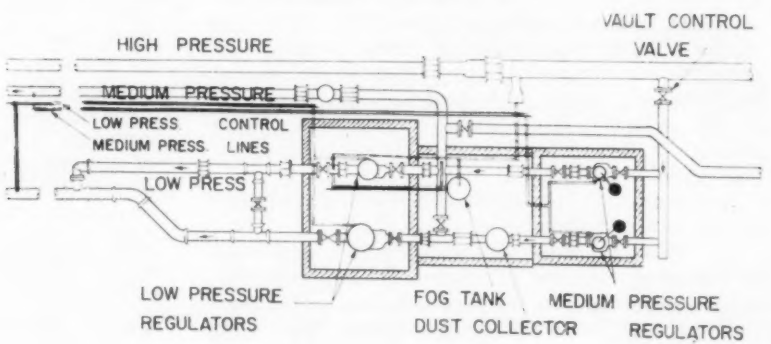


Fig. 3. Series regulator station, 1950.

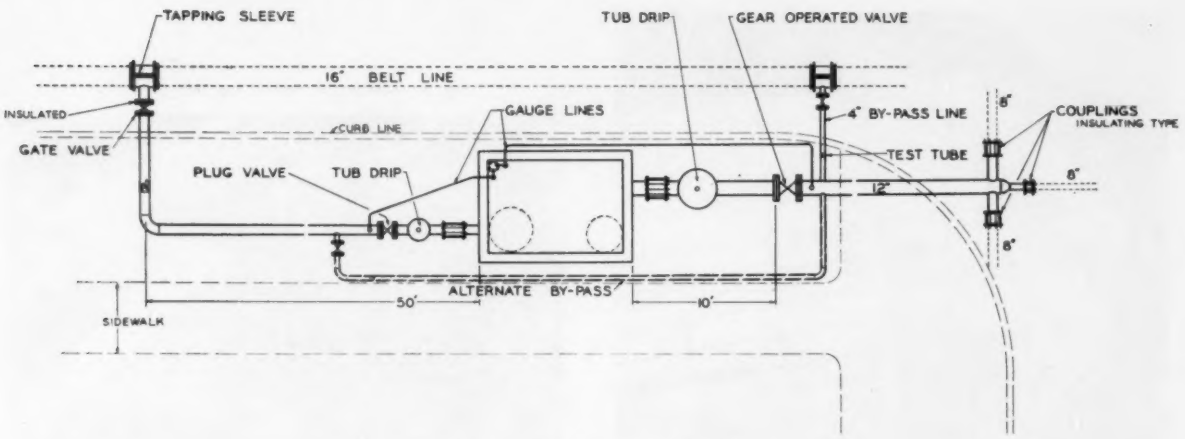


Fig. 4. Typical single district regulator layout.

the New York State Public Service Commission Rules and Regulations and of the ASA B31.1.8 code. You are familiar with the B31 code. For the benefit of those who are not informed about the New York State Public Service Commission Code, the following rules and regulations pertaining to regulator stations are mentioned. Some of these are common to the B31 code.

• 1. All regulator stations shall be provided with relief valves or other protective devices to insure that complete failure of one or more regulator station shall not impose pressures on any part of the system beyond those which it is designed for or protected against. In the case of low pressure systems the number and capacity of the relief valves must insure that the pressure of the gas will at no time exceed a maximum of 2 psig at the inlet of any gas service.

• 2. Double duct ventilation (each duct not less than 4-in. diameter) is required for all underground vaults. Such double duct ventilation must also provide for the venting of the diaphragms of pressure regulators to the atmosphere.

• 3. Alternative protective devices shall be installed if venting of gas into the atmosphere in congested areas creates a hazard to life and property.

• 4. All openings in manhole covers shall be sealed to minimize the accumulation of water.

• 5. Exterior shut-off valves shall be installed on all lines to regulator stations at least 50 ft and not more than 1000 ft from the regulator station.

• 6. For two-stage regulation, the regulators must be installed as separate stations, separated by a distance of at least 50 ft. Failure of one stage, therefore, will minimize any adverse effect on the other stage.

• 7. Drain lines and connections from vaults to sewers are not permitted.

• 8. Vault walls must be waterproofed and sumps must be provided to prevent water accumulation.

• 9. All piping passing through walls or floors shall be tightly sealed to prevent seepage of gas or liquids.

• 10. All auxiliary equipment, such as oil foggers and dust collectors shall be kept to a minimum. No materials nor articles shall be stored in the vault.

• 11. All electrical equipment required for regulator stations shall be installed in compliance with the effective provisions of the National Electrical Code.

• 12. Where supports under regulator equipment and piping are necessary, the supports must be fireproof.

• 13. Manhole covers must be installed in such a manner as to prevent the cover from falling on the regulator equipment and damaging the regulator equipment.

We have standardized on reinforced concrete vaults. Some of the regulator station design features are shown here.

Fig. 4 is a typical regulator layout. There is a shut-off valve 50 ft upstream of the station and a shut-off valve 10 ft downstream. Valves and drips are externally located, minimizing the sources of potential leakage. Compression couplings on the inlet and outlet piping minimize the stress on the regulator flanges. There are no around-the-block controls; the control line is built into the regulator. Although the underground vaults are all behind curb, they are designed to withstand without damage the heaviest loads to which they would be subjected if they were located in the pavement. Where two-step regulation is required, separate vaults are provided which are separated by at least 50 ft.

Fig. 5 pictures the vertical and horizontal reinforcing rods used in the walls of the poured concrete vault. Floor, walls, and roof are tied together by welding of the reinforcing rods.

Fig. 6 shows the reinforcing steel in the top slab just before pouring concrete. The 8-in. pipe in the background is the vent stack. The 30-in. round steel section in the foreground is a removable steel form for the manhole.

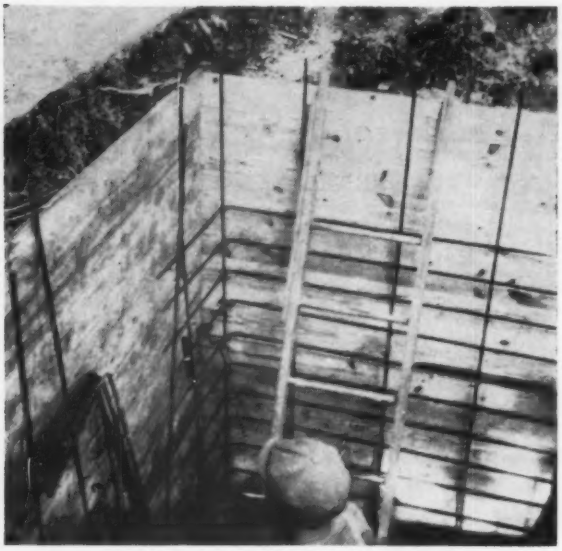
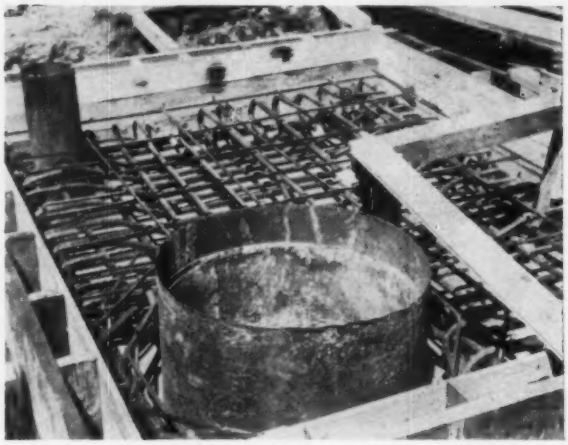


Fig. 5. Vault wall reinforcing rods.

Fig. 6. Reinforced steel in top slab of vault.



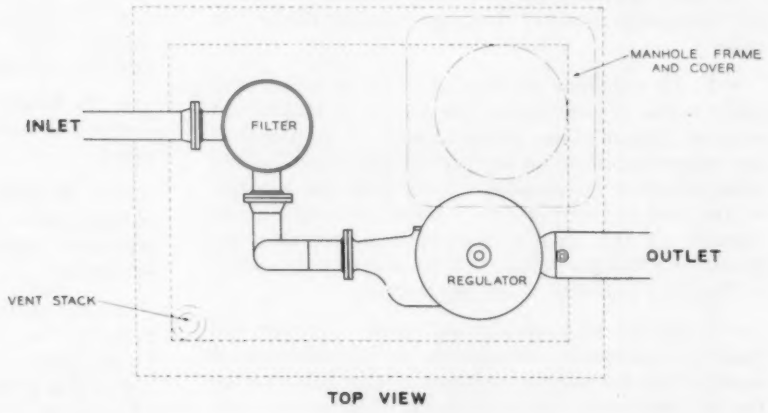


Fig. 7. Standard regulator vault layout—plan view.

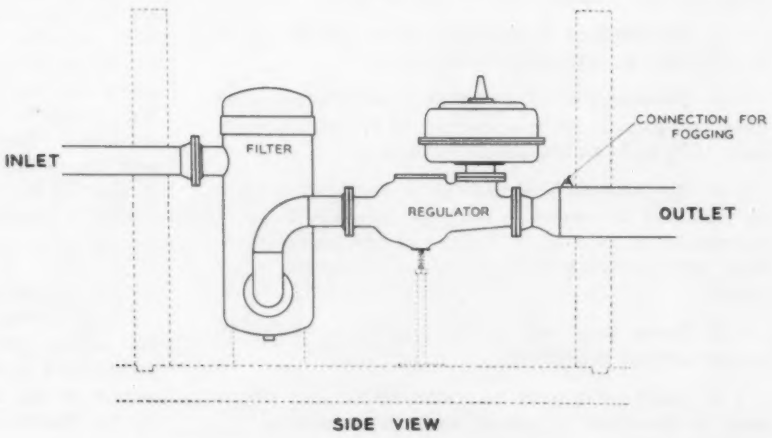


Fig. 8. Standard regulator vault layout—elevation.

Fig. 9. Vent stack details.

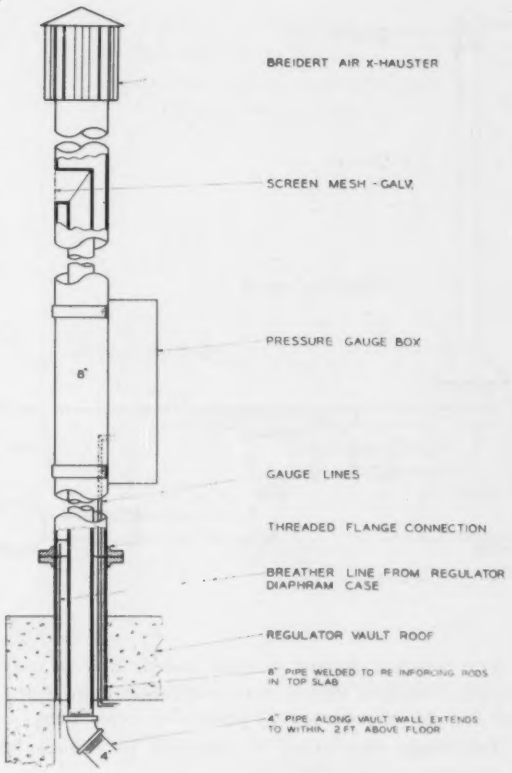

BREIDERT AIR X-HAUSTER
SCREEN MESH - GALV.
PRESSURE GAUGE BOX
8"
GAUGE LINES
THREADED FLANGE CONNECTION
BREATHER LINE FROM REGULATOR DIAPHRAM CASE
REGULATOR VAULT ROOF
8" PIPE WELDED TO RE INFORCING RODS IN TOP SLAB
4" PIPE ALONG VAULT WALL EXTENDS TO WITHIN 2 FT. ABOVE FLOOR
4"

Fig. 7 and *8* show a standard regulator vault layout in plan and elevation, respectively. Each regulator is provided with a dust filter on the upstream side. Only the filter and regulator are housed in the vault, which has ample working space to install, operate, and maintain the equipment. In the interest of safety and because they are located in the limited space between the curb and the sidewalk, the vault is kept as small as possible. We use fully enclosed dead weight regulators for low pressure and pilot controlled regulators for high pressure. Regulators are carefully sized to meet immediate needs.

Fig. 9 represents the construction details of the vent stack. Every regulator pit is vented regardless of size. Vent stacks are essentially a 4-in. air inlet pipe extending almost to the floor surrounded by an 8-in. air outlet pipe which starts at the vault ceiling and extends 12.5 ft above grade. It is topped with a stationary weather proof cap having an effective opening of 96 sq. in. The lower section of the 8-in. outer stack is flanged. This lower flanged section is welded to the roof reinforcing rods, before the roof slab is poured. The top section supports the internal 4-in. air inlet pipe, a gauge box, and two gauge lines. In order to provide a shear point in case a vehicle should strike the stack, the 8-in. pipe is deep threaded for the flange. The annular space between the 4-in. and 8-in. pipe also provides room for the diaphragm vent. A recording pressure gauge showing inlet and outlet pressure is mounted in the gauge box.

The precautions taken to avoid entrance of water into the vault are shown in *Fig. 10*. There is a water seal at the construction joint between floor and walls. Compression couplings and water stops are used as sleeves for inlet and outlet piping. Mastic seal is used under the manhole frame, which in turn is bolted to the roof. The outside of the walls is coated with Bitumastic compound and the inside with waterproof cement paint.

Relief valves are installed near the outlet of every district regulator. They are designed to relieve the maximum capacity of district regulators at the highest inlet pressure. A low pressure control valve layout is illustrated in *Fig. 11*. The dead weight type is used for low pressure. Access to the valve is through a manhole cover installed in a pre-cast concrete slab. The valve can be removed by bagging off the lateral.

Fig. 12 shows a high pressure relief valve. A spring type valve is used. A specially designed valve key is used to operate the valve ahead of the relief valve. The key *cannot* be removed unless the valve is in the open position.

There are other design features that may be of some interest:

- Removable aluminum ladders are mounted on the inside wall at each manhole.

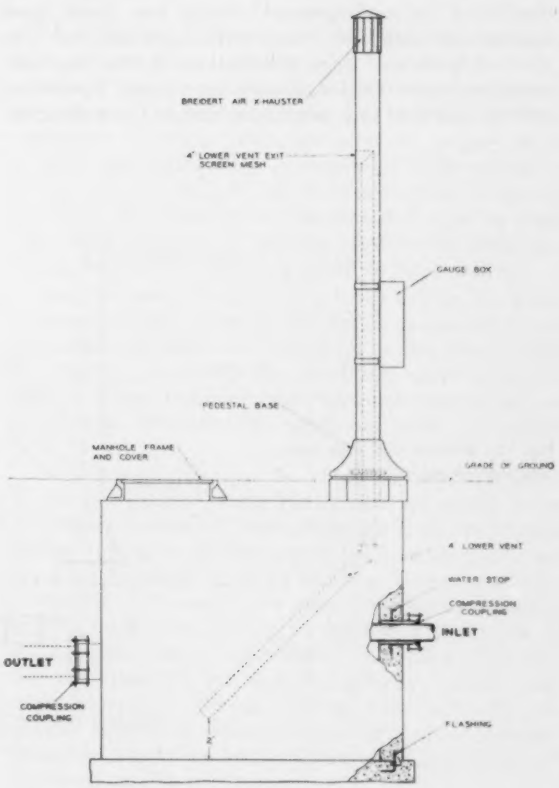


Fig. 10. Measures taken to prevent water entry.

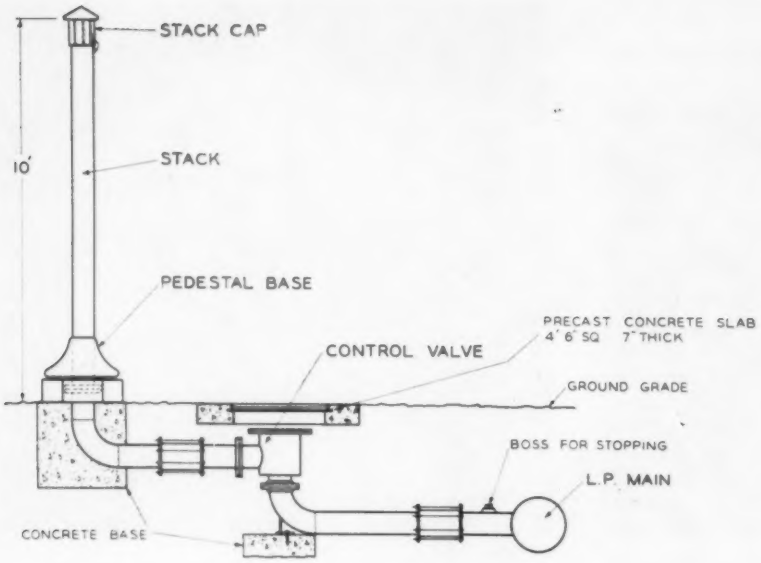


Fig. 11. Low pressure control valve layout.

• The internal piping is color coded. Red is used for high pressure, yellow for intermediate pressure, silver for low pressure, and green for vent lines.

• Two-stage regulation is required to reduce 50 psig or more to low pressure.

• Dual regulators in parallel are used for dead end systems.

• Push button control of high pressure district regulators in underground vaults has been used during the past two years with good results. The unusual feature of these installations is that the vault contains no electrical equipment or wiring. The motor valve is installed in a small weatherproof box mounted above ground on the vault ventilating stack. By depressing a push button the gas dispatcher can raise or lower the regulator pressure as desired.

Serious accidents are usually the result of a chain of circumstances that, on the surface, seem almost impossible. Good design tries to anticipate all of the potentially weak links of the chain. By eliminating all of these potential weak links, a serious accident can be prevented. One good way is the continuance of area conferences to promote the exchange of ideas, experiences, and current practices. This is the stuff that contributes to the best in design. ■

This article is adapted from a talk presented at the Pennsylvania Gas Association distribution conference, March 31, 1960.

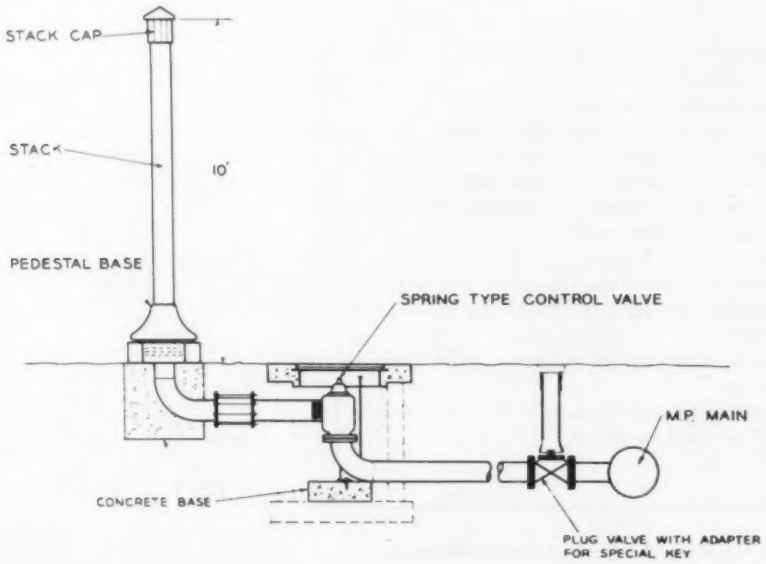


Fig. 12. Medium and high pressure control valve layout.

A pioneer user tells of its

Experiences with plastics pipe

By JAMES L. SANDERS
Southwest Gas Corp., Las Vegas, Nev.

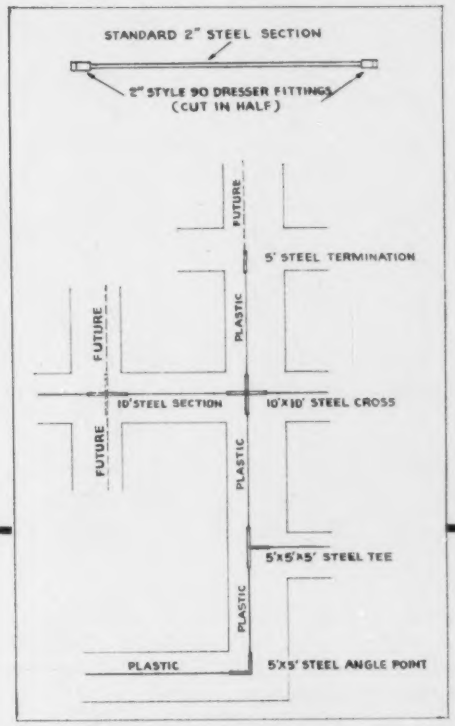


Fig. 1. Typical installation of steel sections in a plastics system.

AT the close of the fiscal year, Sept. 30, 1959, Southwest Gas Corp. had a total of 2 million ft of plastics pipe installed, ranging in size from ½ in. through 2 in. The company first began using plastics pipe for services in 1953. Early in 1958 we started using it for mains. The results to date have been very satisfactory and it is planned to continue its use on about the same scale this year as in previous years. This will amount to about 425,000 ft of 2-in. and 215,000 ft of ½-in. and ¾-in.

There are a great many questions asked about the use of plastic in gas piping systems, as it is a relatively new development in the industry. A considerable amount of material and information is being compiled and published, with more to come as more companies are using plastic on an experimental or operational basis and additional data are being obtained. We have noticed the increased interest from the number of inquiries received concerning our experience.

Of the several companies we have talked with that are now using plastics pipe, it is apparent that many techniques and methods have been developed in its installation as well as the type of plastic preferred. All seem to be enjoying its economy and ease of installation, however.

For this purpose some of the methods and techniques used by Southwest Gas and the governing factors that control its use will be pointed out. The type of plastics used and currently being supplied by Kraloy Plastic Pipe Co. in 20-ft lengths, is high-impact, unplasticized, rigid polyvinyl chloride.

Among the factors considered before a decision to use plastics for any particular job is made is what operating pressures will the pipe be subjected to initially and ultimately. A maximum of 50 psi operating pressure has been set for plastics and if design indicates this pressure will be exceeded, steel is used. This limit of 50 psi for plastics provides an additional safety factor over limits specified by pipe makers.

Another factor considered is what will be the ditch conditions? Will rock or caliche be encountered and will sufficient depth be attainable without too great an increase in cost? By providing extra cover to plastics mains, the mechanical strength limitations are minimized. The specified minimum cover for mains is 36 in.

At this point it should be added that in 1958, when it was first decided to use 2-in. plastic for mains, there was the question of what pressure control fittings, valves and other fittings could be used in a plastics system. As there were no plastics fittings available suitable for the company's operations, it was decided to supplement the plastics by installing steel pipe at various intervals in the system to provide such a spot for the standard line stopper, pressure control and main extension fittings. These steel sections are usually located at street intersections, main terminations and any other location where the probability of its being needed occurs.

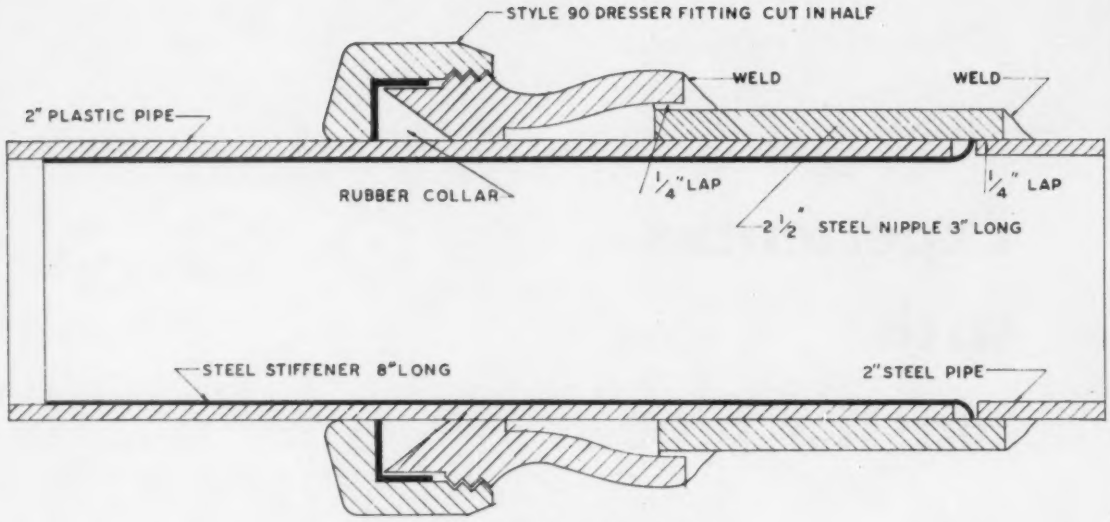


Fig. 2. Plastics-to-steel assembly.

From *Fig. 1*, you can see how the steel sections are utilized. The standard 2-in. steel pipe sections, 10 ft in length, are fabricated in the Las Vegas burner shop, with a Dresser coupling welded at both ends. In this shape they are hauled to the various divisions. At the job site, depending on the type of street intersection involved, they are either installed as they are, or they are cut and welded into a 10-ft x 10-ft cross, a 5-ft x 5-ft x 5-ft tee or a 5-ft x 5-ft angle point. The 5-ft section for main terminations are shop fabricated with the coupling at one end and the other blanked off. A ¾-in. nipple is provided for purging. A stiffener inserted in the plastic is used in all cases when coupling the plastic to the steel. This is illustrated in *Fig. 2*. Incidentally, the steel sections can be detected with a pipe locator in locating mains.

In the installation of plastics pipe in addition to the particular attention given to obtaining sufficient depth as previously mentioned, great care is taken to compensate for the relatively large coefficient of expansion characteristics of plastic. For instance when ground temperatures vary from 80 deg F to 40 deg F, there is a contraction of 2 to 3 in. for every 100 ft of pipe. This compensation is made using a combination of snaking or crowding the pipe in the ditch and making tie-ins during the cool of the day. Too much snaking will put a stress on the couplings at pipe joints and could prevent a proper solvent weld. For this reason, an effort is made to lay the plastic in sections, shading the pipe and then making the tie-ins during the coolest time of the day. Services very nearly have to be snaked in the ditch because of their limited length. However, an "expansion joint" in the form of a 90-deg turn is provided in service lines.

The Mueller Kralastic service tee is used for services from plastics mains. As the main is PVC, a slower acting solvent is used for solvent welding the tee to the pipe. This solvent reacts to both PVC and Kralastic to form a solid fusion. After the solvent is applied, the tee is set on the main with the installation clamp and held for 20 to 30 minutes for the initial set.

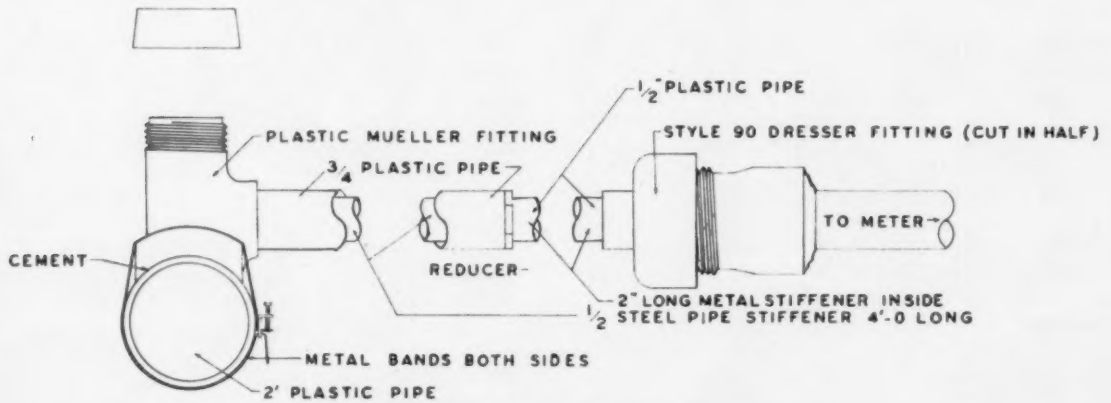


Fig. 3. Plastics service from plastics main.

The clamp is then removed and ordinary hose clamps are permanently installed to insure a firm grip until the solvent has completely set. Subsequently the tap is made.

The procedure for installing plastics services is much the same as that for mains. Here again, certain features are incorporated to minimize plastic limitations, namely, mechanical strength. Due to the difficulty in obtaining proper compaction under the service line where it crosses the "bell hole" at the main, a bending stress occurred during back filling and subsequent traffic loading. This stress was minimized by the use of steel pipe. In the case of a plastic service from a steel main, the first 4 ft of the service is ¾-in. steel. In the case of a plastic service from a plastic main, a 4-ft section of ½-steel pipe is inserted in the plastic to serve as a stiffner. This is detailed in *Figs. 3 and 4*.

The minimum depth of a plastic service is 24 in. At the take off from the main, the depth is necessarily the same as the main. However, it is eventually reduced to 24 in. at the service riser. The service lines are located approximately 2 to 6 ft from the property line and a 90-deg turn into the meter set is made. This location, in most cases, will clear future post holes and home gardeners excavatings. Most important of all, however, is the expansion joint provided for in the 90-deg turn to the meter set as previously mentioned. In all cases the riser is of steel; these, too, being fabricated in the burner shop with a Dresser coupling and stop cock.

In an area such as Southwest Gas serves, mainly the desert area, a good portion of the customers are quite scattered. This is evident from a meter density of 34 customers per mile of main in the California division. However, the investment of $350 per customer appears favorable with comparable companies. A good deal of the credit for this is attributed to the use of plastic with its economical advantage. As an example, last year the Victorville district of California showed that the total direct cost of plastics mains installed was 58.9 per cent of that experienced with steel mains. Included in this figure are labor and equipment at 51.2 per cent of the cost of steel and pipe and material at 62 per cent. This amounted to considerable savings considering that 119,000 ft of plastic main was installed in this area.

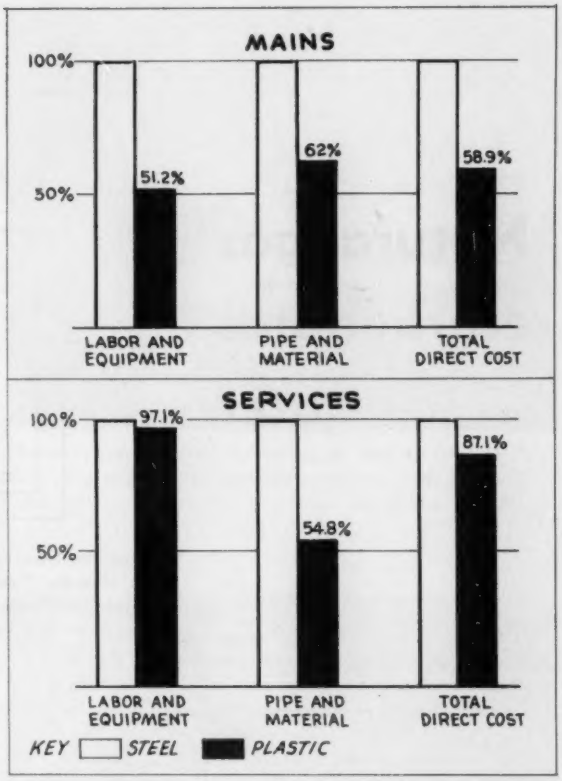


Fig. 5. Comparison of costs between plastics and steel, expressed as a percentage to steel.

While the difference in the cost of services was not so great, the savings is still quite evident. For this same area, the total direct cost for installed plastic services was 87.1 per cent of that of steel. Labor and equipment being 97.1 per cent and pipe and materials amounting to 54.8 per cent. ■

This article is adapted from a talk presented at the PCGA's distribution conference held in Portland, Ore., April 28-29.

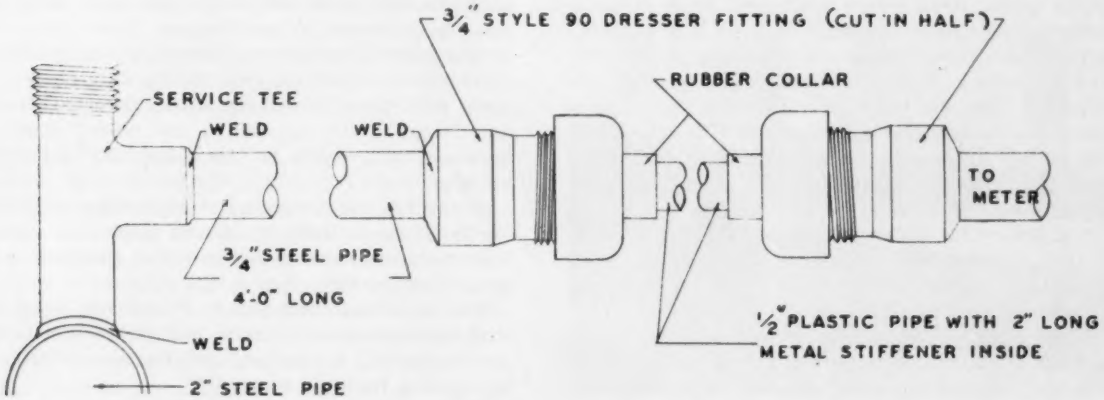


Fig. 4. Plastics service from steel main.

Natural gas recarbonates water

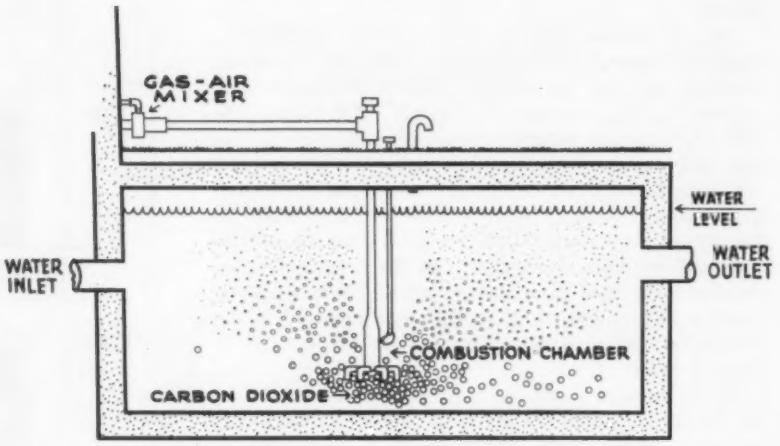


Diagram shows operation of submerged combustion burner in the recarbonation process at Meander Creek reservoir. Carbon dioxide is introduced into the water to neutralize excess lime. Natural gas and air, piped to the burner located 10 ft below the surface of the water, are combusted to produce the carbon dioxide which joins the water swirling by the burner.

VERSATILE natural gas, burned in submerged combustion units, is playing an important role in water purification in Ohio's highly industrialized Mahoning valley.

Meander Creek reservoir is the scene of this unusual application where gas is used in the exacting science of bacteria and algae control. The reservoir supplies Youngstown with a daily average of 24 million gal. of water and Niles with 7 million.

The gas is employed for recarbonation. In simpler terms, natural gas neutralizes excess lime after it has achieved its purifying effects.

Meander Creek reservoir, with a capacity of 10 billion gal., is supplied by a natural watershed of 86.5 square miles. Even before treatment, every effort is made to insure that the water is in no way contaminated. There is no fishing nor swimming in the 2010 acres of water. A 35-mile long fence completely encloses the 5500-acre tract which is under the jurisdiction of the Mahoning Valley Sanitary District. About two million evergreens border the lake area; their needles cause far less taste and odor trouble than the falling leaves of other types of trees.

And before the water is pumped to homes and industry in Youngstown and Niles, it is treated in an atmosphere strongly analogous to a mother preparing formula for a young baby:

Alum is added for removal of silt, clay, color and bacteria; soda ash is mixed in to rid the water of hardness. Activated carbon removes taste and odor caused by algae growth. Lime is mixed in to separate carbonate hardness and iron from the water and to control bacteria. Chlorine and ammonia are added after filtration to insure disinfection of the water; fluoride is added for dental health.

Under normal circumstances, water flows by gravity from the huge reservoir to the treatment plant. It is screened and the chemicals, precisely measured, added. The water is then sent to settling basins for removal of suspended matter, and then filtered through sand to remove the last traces of such matter. This, simply stated, is the normal process of softening, filtering and disinfecting the water at Meander.

However, during certain times of the year, usually in the spring when there is heavy rainfall, the water of many isolated pools within the watershed are carried into the main reservoir. And from these pools come heavy doses of bacteria and algae. Extra lime is then added to counter the additional foreign matter.

At other times of the year, minute animal life, crustacea with the awe-striking names Bosmina, Cyclops and Daphnia, are present in the water. They are harmless, but visible to the naked eye under close scrutiny.

Mindful of the psychological impact they could have on water users, Meander officials make sure that the little creatures never enter the water distribution system by adding extra lime at the plant.

The additional quantities of lime efficiently deal with the crustacea, bacteria and algae, but in turn present another taxing problem. The excess lime must be removed from the water.

This can be accomplished by several means. Sulfuric acid or bicarbonate of soda, added to the lime-

laden water, will trigger the necessary chemical action. Both, however, have serious drawbacks. Sulfuric acid is extremely dangerous to handle and has corrosive qualities. Bicarbonate of soda is very expensive.

The most practical method is to introduce carbon dioxide into the water.

For years, Meander produced carbon dioxide by burning coke and then forcing the coke-produced carbon dioxide into the water. This process had many disadvantages. The operation was highly complicated. And equipment maintenance and labor costs were very high.

With the extension of gas lines to the Meander area by East Ohio Gas Co., Meander officials saw recarbonation with natural gas as the ultimate answer. Gas, they knew, would be much more efficient than coke and their studies showed that it would cost about one-seventh as much as bicarbonate of soda.

Last year, spurred on by Meander's Chief Engineer Luther T. Fawcett, the planning was begun. Installation was completed in May of this year.

Backbone of Meander's new recarbonation process are three Ozark-Mahoning submerged combustion burners—two of 1944-cu ft an hour input and a smaller one of 972-cu ft an hour input—capable of producing 10,000 lb of carbon dioxide a day.

The burner assemblies are located in two carbonation basins, with combustion taking place in chambers about 10 ft below the surface of the water. The basins are located one within the other with a large burner located in the outer basin and a large unit and small burner in the inner basin. Both basins are independent of each other; they can be used simultaneously or alternately.

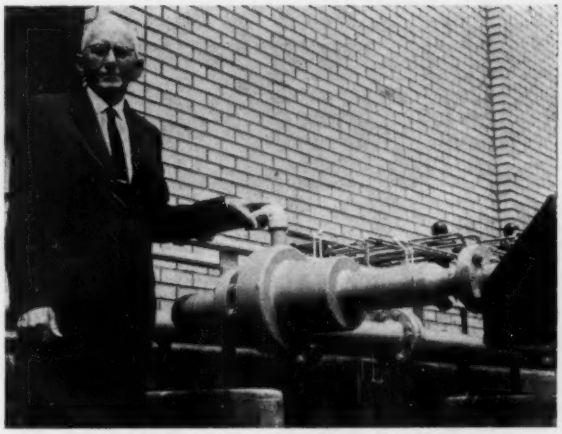
Natural gas at 8 or 9 lb pressure is combined with air at a ratio of 1.03—1.05 to 10 in a mixer immediately before it is piped to the combustion chambers. The pressure of the gas is sufficient to keep the water out of the burner assembly. Carbon dioxide, a product of the combustion, emerges from the chamber of each burner through eight outlets set in circular fashion.

Adjacent to each carbon dioxide outlet on the burners is a jet where small streams of water are forced out at a pressure of 100 psi to break up the carbon dioxide bubbles for quicker absorption.

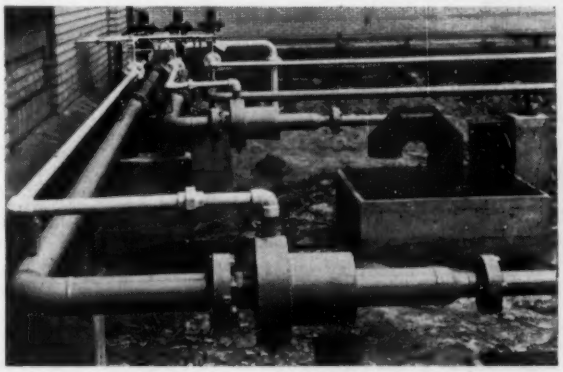
Ignition of the submerged burners is achieved manually. Air is introduced into the combustion chamber where an electric igniter is energized and allowed to heat for approximately 30 seconds before the gas is introduced. A magnetic valve in the gas line is automatically closed, and sounds an alarm, in the event of a flame failure.

Both Fawcett and Merrill L. Riehl, superintendent of purification at Meander, agree that the installation of the three gas-fired recarbonation units have increased the plant's operating efficiency and lowered costs. They point out to get the recarbonation process in action when coke was being used required about two days lead time. With gas, a maximum of 30 minutes is needed. The new process also has resulted in a considerable saving in manpower.

The Meander recarbonation installation was designed by the New York engineering firm of Parsons, Brickerhoff, Quade & Douglas. ■



Meander's chief engineer Fawcett poses next to some of the piping used for the submerged combustion burners. His hand rests on the gas line as it enters the gas-air mixer.



View of some of the piping above the submerged combustion burners. Air is conveyed in the large pipe; gas in the smaller one to the mixer (center foreground) before it is piped to one of the three burners. Note the question-mark shaped vent pipe. Recarbonation basin is directly beneath the area shown in the photo.

Fawcett (right) and Merrill L. Riehl, superintendent of purification, examine one of the settling basins at the plant.

GAS DISTRIBUTION NEWS

Lone Star fosters friendship

Ringing out with the theme: "More than 6000 friendly people working together to serve our communities better," Lone Star Gas Co., Dallas, has launched one of the most dynamic and largest continuing promotion programs in the gas industry. Of course, Lone Star Producing Co. is in on the program too.

"Lone Star's community responsibilities do not stop with the rendering of a complete gas service," said L. T. Potter, president of the two companies. "We have the additional responsibility of functioning as a 'good citizen' in all areas of our operations . . . community service, if you please, rendered by working in behalf of church, civic, welfare and other worthwhile community enterprises.

"This is not a crash program to be conducted for a short time, then dropped," he continued. "It is a long-range program designed to strengthen and enhance Lone Star's reputation—reflecting the total impression made by Lone Star on the public."

Mr. Potter added: "Our public is not limited to the customers of Lone Star. It also includes shareholders of the companies, dealers, suppliers, financial groups, people from whom we lease land and mineral rights, governing bodies who help define the framework of our operation, non-customer residents of our communities, and every single member of the Lone Star organization."

The Lone Star president emphasized that Lone Star people are the foundation of the program. "Our people," he said, "are encouraged to earn even greater respect, confidence, and trust from the people we serve."

Mr. Potter explained that a 10-point guide has been adopted for Lone Star people to use in their everyday, regular work.

Examples of some of the 10 points are: To support the American system of competitive enterprise as the foundation of democracy, freedom and prosperity, and a higher standard of living for all.

To conduct business in such a way as to remain financially stable, sound and healthy so that successful operations may be continued.

To place Lone Star people in a position to work in such a manner that the best possible results will accrue to them, their communities and their company.

To render service of such high type as to earn general approval, appreciation and good will of the customers and communities Lone Star serves.

The enlarged promotion program was developed under the supervision of Charles G. Barndt, Lone Star Promotion director.

"Purpose of the program," said Barndt, "is to cause people to think well of us. Many of our employees have been doing a superlative job in this respect for a long time. Their efforts have helped to develop public confidence in the value and integrity of Lone Star."

The promotion program theme of "More than 6000 friendly people working together to serve our communities better" will appear on Lone Star stationery, gas bills, truck cards, personalized business cards, sales promotion materials, home economics bulletins, shareholders reports, newspaper, radio and TV advertising, employee magazine masthead and other promotion media.

Pachyderm platform planks

Last month in Thermally Thinking, we presented points from the Democratic Platform of particular interest to the gas industry.

Republicans came up with what most observers agree is a more conservative platform. They did not advocate further development of giant electric power generating facilities nor did they mention that low-cost loans should continue to be doled out to REA. Republicans apparently will not support a national fuels policy, but they did say that "long range minerals and fuels planning and programming, including increased coal research," are needed.

The GOP also pledged: "Continued support for federal financial assistance and incentives under our tax laws to encourage exploration for domestic sources of minerals and metals, with reasonable depletion allowances." And "Broadly based tax reform to foster job-making and growth-making investment for modernization and expansion, including realistic incentive depreciation schedules."

The Nixon-Lodge backers went on record for ". . . keeping the federal government from unjustly competing with private enterprise upon which Americans mainly depend for their livelihood."

In its Conclusion, the Republican Platform had this to say: "There are many things a free government cannot do for its people as well as they can do for themselves. There are some things no government should promise or attempt to do. The functions of government are so great as to bear needless enlargement. We limit our proposals and our pledges to those areas for which the government of a great republic can reasonably be made responsible. To the best of our ability we have avoided advocating measures that would go against the grain of a free people."

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NI-Gas eyes new storage area

Northern Illinois Gas Co. plans to develop another underground storage area, this one in the Crescent City (Ill.) area.

With NI-Gas as an interested partner, the 7500-acre site was first probed for oil with no success. But, M. G. Markle, vice president in charge of engineering for the company, said studies show the inverted saucer-shaped St. Peter sandstone stratum at the 1200-ft level can be developed into a successful natural gas storage reservoir.

Already slated for use this winter is 100 MMcfd from the new Troy Grove (Ill.) storage operation. Markle said preliminary study of Crescent City shows that it will provide about the same daily supply. NI-Gas plans to have Crescent City ready by the 1961-62 heating season.

NI-Gas has taken preliminary steps to obtain additional gas from Midwestern Gas Transmission Co. for injection into Crescent City.

Midwestern's big Portland-to-Joliet line is adjacent to a one-acre parcel of land NI-Gas has option to buy for a tap station site.

With ICC approval, NI-Gas will build an 11-mile line this summer from the Midwestern tap to the storage area. Target date for initial injections is early fall.

Rx FOR SURE PROTECTION

You've made a worthwhile investment in this pipe. You've spent some more on cleaning and coating. Why risk the cost of digging it up in a few years to repair corrosion damage?

With ERP protection you won't need to. Electro Rust-Proofing takes care of those pinpoints of corrosion that even the best coating cannot prevent. When your pipeline is laid, ERP makes a test survey to determine your needs. Once cathodic protection is installed, a periodic service visit by ERP engineers keeps your pipeline new—for good. They adjust your protection as your needs or environmental conditions vary.

ERP installs corrosion protection anywhere . . . at any time. But your greatest savings come if you call ERP early . . . if you plan your protection while you plan your pipeline. Write ERP today—Dept. E.55.41.

ERP CATHODIC PROTECTION SINCE 1935

ELECTRO RUST-PROOFING CORP.
A SUBSIDIARY OF WALLACE & TIERNAN INC.
30 MAIN STREET, BELLEVILLE 9, NEW JERSEY
CABLE: ELECTRO, NEWARK, N. J.

Air-conditioning leasing plan offered

Lone Star Gas Co. has launched a gas air conditioning unit lease program, believed to be the first of its kind in the Southwest.

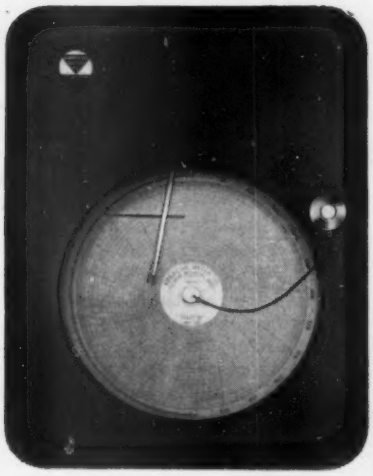
While Lone Star feels that the program will be particularly attractive to businesses, the plan also is available to residential customers. Certain businesses may accrue tax and conservation of working capital benefits by leasing instead of purchasing.

The leasee can obtain summer comfort for a nominal monthly charge with no further concern for such items as maintenance, routine service, or capital outlay. The lease term is for a 12-month period. Monthly leasing charge includes delivery and installation of unit, installation of concrete slab, necessary coils, water piping, thermostats and wiring. There is no charge for service or replacement of any part on the lease equipment.

Lone Star is offering two models of Bryant gas air conditioners under the program.

Propane storage okayed

Baltimore (Md.) Gas & Electric Co. can build an underground propane storage plant in Baltimore county. Approval of the plan came after it was found that the facility would not interfere with development of a state park.



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American® single and two-pen *Pressure Recorders* for pressures from 30 inches vacuum to 10,000 psi.

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- No ambient temperature errors.
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Ask for Bulletins 400 and 408

AMERICAN®
METER COMPANY
INCORPORATED (ESTABLISHED 1836)
General Offices: Philadelphia 16, Pa.
Sales Offices in Principal Cities

Innovations highlight Arizona rate increase

Arizona's Corporation Commission has approved Arizona Public Service Co.'s rate application, which has been under fire almost constantly since it was filed in August 1959. The Phoenix-based company was allowed a 5.8 per cent return on gas property fair value; 5.4 per cent on overall company operations.

An innovation in rate-making for residential gas space heating was approved. This prevents unusually high customer heating bills during periods of excessive winter weather. And, it tends to equalize the company's income from year to year, making both bill and revenue less vulnerable to vagaries of weather. The heating rate is discounted in proportion to the severity of winter weather.

Discount factors are computed separately for each of the company's eight geographical gas service areas having different weather conditions. In addition, weather conditions during the 30 days ending with the meter reading date are taken into consideration. These provisions assure non-discriminatory billing regardless of location or condition of weather during the billing cycle.

New line increases Southern Union supply

Construction has started on Southern Union Gas Co.'s 6.5-mile, 8-in. line to connect new gas supplies in southeastern New Mexico. The new line connects Southern Union's Artesia Junction compressor station with Pan American Petroleum Co.'s Empire Abo gasoline plant near Artesia, N. M.

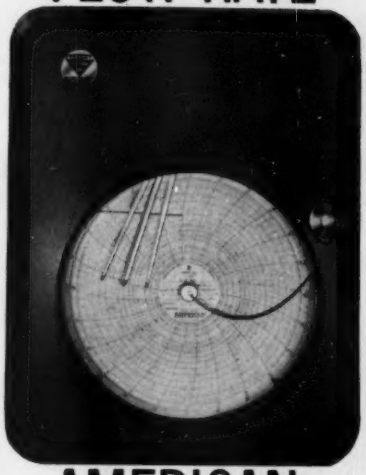
This is the second gasoline plant near Artesia connected with Southern Union's compressor station within the last six months. The earlier connection was made with Skelly Oil Co.'s Maljamar plant.

The Pan American installation will increase Southern Union's gas take from the two plants to 20 MMcfd.

Citrus men switch to gas

Houston Texas Gas & Oil Corp. is serving directly about 87 per cent of the citrus concentrate and pulp processors in its Florida service area. Latest contract is with Adams Packing Association Inc., Auburndale citrus processor.

PRECISION MEASUREMENT AT ANY FLOW RATE



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A-88

ORIFICE METERS

Versatile American® Series A-88 mercury-type orifice meters meet the toughest flow measurement requirements – working pressures to 5,000 psi – interchangeable 10, 20, 50, 100 and 200-inch ranges. Recording meters may be equipped with 0-150° F. standard temperature element. Integrating meters integrate static and differential pressure, providing totalized flow indications. Telemetering equipped meters transmit integrated indications to remote locations.

- Manometer body easily cleaned – does not affect calibration.
- Tamper-proof calibration – simple, positive adjustment of float lever arm length.
- Interchangeable ranges – no manifold piping changes.
- Teflon-packed stuffing box is pressure tight, nearly frictionless, never needs lubrication.
- Teflon-packed pulsation dampener externally adjustable under full line pressure.
- Check valves give positive shut-off for over-range protection.

AMERICAN®
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Michigan jumps on Panhandle sales plan

New shots have been fired in the long-standing feud between Michigan Consolidated Gas Co. and Panhandle Eastern Pipe Line Co. Caught in the middle is Ford Motor Co.

Michigan Consolidated sells about 4.5 billion cu ft of gas to Ford's River Rouge plant at a price of 42.2 cents per Mcf for interruptible and 58.3 cents for firm gas.

Panhandle offered to sell interruptible to Ford at 35 cents a thousand. And, Ford wanted to buy it.

Upon learning of the offer, Michigan Consolidated jumped in and flooded consumers in Dearborn, Mich. (Ford's headquarters) with leaflets estimating that the Panhandle-Ford deal would cost every gas-using homeowner an extra $5.50 a year. By losing such a big chunk of its industrial business, Michigan Consolidated said its profits probably would fall below the allowed minimum of 6.5 per cent, and Michigan PSC would grant increased rates almost automatically.

Sympathetic reaction came from Detroit's mayor, the city council, the Wayne county prosecutor, the city attorney and others. Rallying to the homeowners defense, they scolded Ford for trying to buy its gas at a cheaper rate.

Ford tried to calm the uproar by offering to continue buying the same amount of gas from Michigan Consolidated, taking any excess needed from Panhandle at the lower rates. Michigan rejected this plan, calling it "an absolute sham which changes nothing."

Grayson expands

Construction is under way in Long Beach, Calif., on a new 10,000-sq ft facility for Robertshaw-Fulton's Grayson controls division.

The new structure is in the form of a wing adjoining existing buildings. Scheduled for late October completion, the $175,000 facility will provide additional engineering space for the design, development and testing of new control devices.

Lancaster
non-crack SYNTHETIC DIAPHRAGMS

improve gas meter accuracies without changing index gear ratios . . . without fabric failure

Gas meters operate at regular speed with Lancaster diaphragms S-7-L (and S-70-L with new adjustable height side carrier and oval-slot center bracket) for 1-A, #240 and Beta gas meters!

You increase meter accuracy without increasing meter wear. There's no cloth lining to cause fabric failure . . . no need to change standard meter parts . . . no need to hurry up meter wear.

Actual service and laboratory tests have proved the high flexibility low differential and superior performance. Order Lancaster Synthetic Diaphragms.

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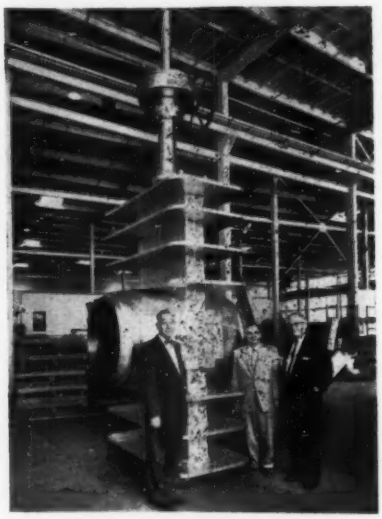
Catalog No.	Sprague
S-70-L	1-A
S-70-L-240	240
S-7-L	1-A
S-7-L-240	240

Other Lancaster Synthetic Diaphragms	
C-1-L	#1 Ironclad
O-L	#0 Emco
1-L	#1 Emco

See catalog for complete line of leather diaphragms



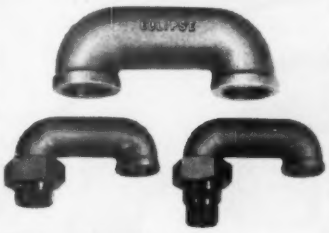
Largest ever

This giant conduit gate valve was installed in Peoples Gas, Light & Coke Co.'s new pipeline network in Chicago recently. Before shipping it from their Oakland, Calif. plant, these Grove Valve & Regulator executives posed before it (from left): President Marvin Grove, Vice Presidents Austin Bryant and George Doty. The 36-in. valve stands over 18 ft tall, weighs 20,875 lb. It is believed to be the world's largest through-conduit valve ever put in pipeline service.

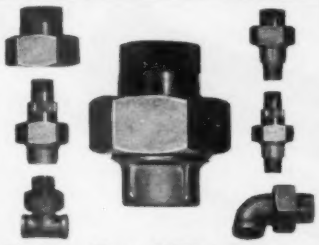
Eclipse

GAS SERVICE PRODUCTS

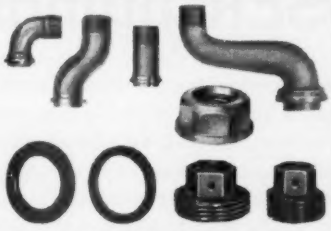
For Safer, More Attractive and Economical Meter Installations



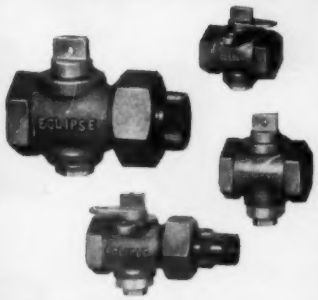
Return Bends
Cut down number of threaded joints, save pipe fitting time, and assure parallel piping in your meter sets. Plain and Wedgeseal-Insulated, female by male and female by female. Bulletin No. 500-2.



Unions, Tees & Elbows
A wide variety of Wedgeseal-Insulated types with versatile combinations of male or female threaded ends. Accurate, time-saving, and effective insulation. Bulletin No. 400-2.



Swivels, Nuts, Accessories
"Certified" construction, accurately machined. Complete stock of straight, offset and adapter swivels and nuts. Bulletin No. 300 for swivels and nuts; No. 1900 for accessory items.



Gas Cocks
Iron body, red brass core with either standard or "Retained Key" construction. Also furnished with integral Wedgeseal-Insulated union either male or female. Bulletin No. 600-2.

Rigid Meter Bars
Union, sleeve or compression type. Union type available in Wedgeseal-Insulated, standard gasket, or brass-to-iron ground joint — with standard key or "Retained Key" integral gas cock available. Bulletin No. 200-2.

You benefit from one source of supply, one responsibility with Eclipse Gas Service Products. Dense, solid castings — free from porosity — are used throughout with accurately machined collars, pilots, and threads.

Eclipse Wedgeseal-Insulated union, meter bar, gas cock, and return bend packages offer 100% protection against stray or induced house currents . . . prevent electrolytic corrosion . . . the multipurpose units cut down on the number of threaded joints in your gas service piping and meter installations. The integral insulator cannot be left out — nor will it shear off, pull out, or crack during service. Ask for descriptive bulletins and specification sheets.

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SUPERIOR GASKETS— Specially compounded for gas service, Dresser gaskets last as long as the pipe itself. They are continuously tested for plasticity, resiliency and low permanent set.

ABSORB PIPE DEFLECTION— Up to 6° pipe deflection at each joint! Vastly simplifies joining in cramped quarters, fittings 100% air-tested to provide a perfect, leak-proof seal . . . permanently!

Bury your service line problems for good...with DRESSER® fittings

• The design of Dresser Service Fittings provides for gasket sealing pressures greatly in excess of recommended line working pressures, with ample margin for permanent safety. The economy of their maintenance-free performance has been time-proved on millions of service lines across the country. Safe, simple and fast: corrosion-resistant Dresser Service Fittings let you bury your worries when you backfill the trench. For specifications, product properties, illustration of the *complete* line, and a summary of standard, current practices, send for your free copy of the Dresser Gas Service Fittings catalog form No. 5210.

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DRESSER
MANUFACTURING DIVISION

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Lone Star balances summer-winter loads

Lone Star Gas Co.'s Dallas division will soon boast a summer gas load almost equal to its winter load.

At midnight on Dec. 25, Lone Star will begin moving gas to Dallas Power & Light Co.'s four steam-electric generating plants where the majority of the fuel is consumed during summer. Present estimates show that next summer DP&L will be using almost the same amount of gas consumed by some 211,000 Dallas division customers during the heating season. Lone Star's contract with DP&L runs for 21 years.

Lone Star already is supplying about 40 per cent of the power company's total gas. Most of it is consumed at the North Lake plant.

Under construction are pipelines and gas measuring and regulating stations for Dallas Power's three other steam-electric generating plants. United Gas Pipe Line Co. will supply these plants until its contract expires on Dec. 25.

Lone Star's measuring and regulating station serving the North Lake plant has a designed capacity of 10 MMcf per hour—200 MMcfd. It is the largest single measuring point on the company's system, including city gate stations in the large cities on the system.

The station is completely automatic. Four 16-in. meter tubes are put in and taken out of service, as the load demands, by pneumatic cylinder operators installed on plug valves on the outlet of each tube. Two automatic motor-valve type regulators also come in and out of service as the load demands.

Monitoring is done at Lone Star's Dallas division central service center some 20 miles from the station.

Interior view of instrument and meter room of Lone Star's measuring and regulating station at DP&L's North Lake generating plant.

Telemetering transmits inlet and outlet pressures and gas flow through each of the four meter tubes. These six functions are sent over a single leased telephone circuit.

Each of the six transmitters operates on a different frequency and all six frequencies are transmitted at the same time. A tone receiver in Dallas unscrambles the tone frequencies. Then, it changes each back to an electrical impulse which is wired to a chart recorder.

Number of recorders required is minimized by a "P delta P" transmitter, which computes hourly flow through each meter tube and records the data as the percentage of maximum flow for that particular tube. A simple reference table is used to find the flow in cu ft per hour.

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GOODMAN USED SINCE 1897 2" HANDLE & LOCKING SLEEVE GAS MAIN STOPPER

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STYLE 38 6-BOLT COUPLING

pipe coupling,

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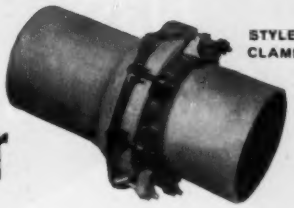
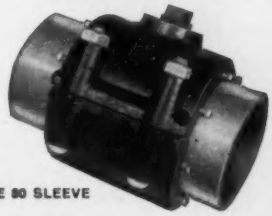


STYLE 60 CLAMP

or

repair sleeve



STYLE 80 SLEEVE

for every need

Only Dresser manufactures a complete line.

DRESSER MANUFACTURING DIVISION

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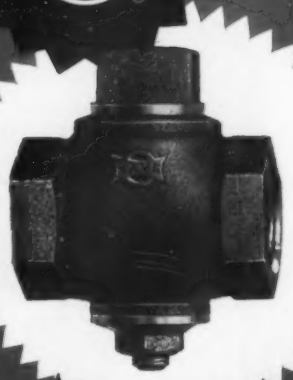
HAYS



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SERVICE LINES
Low, Medium and High Pressure

METER SETTINGS
Flat Head • With or Less Check
Lock Wing

INDUSTRIAL USE
Three-Way • Graduated Dial

APPLIANCES and EQUIPMENT
Lever Handle • Square Head
Flat Head
A.G.A. Listed Control Valves

GENERAL PRODUCTS DIVISION
HAYS MFG. CO.
ERIE, PA.

Seeks regulatory changes in Indiana

Indiana's public counselor George L. Diven has recommended drastic changes in the operations of the state's PSC. He urged that the duties of the three commissioners be confined to hearing cases and handing down decisions.

Diven proposes that the state legislature set up an administrative division to handle the actual running of the regulatory department.

He would also have the law specify that at least one commissioner preside at all hearings and that evidence should be reviewed by the full commission before any decision is reached. He said the majority of cases presently are handled by hearing examiners.

"The commission," he declared, "cannot act properly as both judge and prosecutor. It now controls the technical staff which investigates the petitions for rate increases and, therefore, prepares the case it is expected to decide impartially."

His proposed amendments would limit the commission's decisions to the evidence introduced at the hearing, making it impossible for the commission to seek additional data to support a conclusion it desires to reach.

Under his plan, the administrative division would be required to turn over its evidence to the public interest in all rate cases. To do this, he said his office should receive the reports of commission engineers, auditors, and accountants before a case reaches hearing.

"My proposed amendments would make the (commission) a judicial fact-finding body with no responsibility for the general operations of the office which would be handled by an administrative officer who would have nothing to do with the hearings," Diven said.

Vermont may go natural

Vermont Gas Corp., Bennington, is feeling more optimistic about getting natural gas for southwestern Vermont.

Frank Prideaux, vice president of the company, said he expects to know soon if Tennessee Gas Pipe Line Co. will supply them. If TGT says no, Vermont Gas will go to Trans-Canada Pipe Lines Ltd. for a supply.

If the gas comes from TGT, Vermont Gas will build a $600,000 line to pick it up at the Vermont border.

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- CYLINDERS
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EASILY, QUICKLY AND SAFELY WITH

AUTO CRANE

Now one man with suitable model AUTO CRANE can perform work presently being done with larger equipment — *and do it in less time, with less help and with greater safety!*

Approved by insurance safety committees, battery-powered AUTO CRANE rigs up fast. All models feature a combination of hoist and boom which makes it *the most versatile handling equipment on the market today!*

Write today for illustrated literature, specifications and price lists on all models of AUTO CRANE.

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Flexible pipeline gets final okay

Magna Pipe Line Co. has won its fight to pipe natural gas to Vancouver Island, British Columbia, despite appeals by rival Island Transmission Co. Ltd.

Flexible pipe with a plastic center will carry the gas to Vancouver Island. A specimen shown at Victoria, B. C. by Transport Minister Wicks had a dozen layers around the plastic—including lead, steel, and rubber.

In the $16 million program, a special ship will unreel the 8-in. pipe in sections several miles long, in just the same way as underwater cable is laid.

According to Wicks, the whole 21-mile section across the Straits of Georgia can be laid in less than two days.

Completion of the project is scheduled for the fall of 1961.

Pacific Lighting's earnings rise

A cooler winter in 1959-60 resulted in increased earnings for Pacific Lighting Corp. in the 12 months ended June 30. Earnings were $27.1 million, equivalent after preferred dividends to $3.16 per share on the average number of shares outstanding.

Chairman Robert W. Miller said this compares with $2.59 for the similar period in 1959, and $3.03 for the 12 months ended in March 1960. New customers and higher rates also contributed to the company's increased earnings.

Safety record set

Lone Star Gas Co.'s Abilene district of distribution is the first operating unit of the company to work 2 million manhours without a disabling injury. An average of 112 employees compiled the record, which extended from Aug. 20, 1949 to May 20, 1960.

Commission distributes gas

It is reported that the British Columbia Power Commission is going to distribute gas in the northern part of the province.

According to Chairman Hugh Keenleyside, the commission will serve 253 communities.

SAVE!
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RIDGID
From $25 to $450 a year on Oil Alone . . . with a
RIDGILR!
How much oil do you use each day threading pipe, rod or conduit by hand or power drive?
One-half pint? One gallon? If it winds up on the floor, you're spending somewhere between $25 and $450 a year just for the privilege of cleaning up oil.
The RIDGILR saves that money for you . . . lets you use all the oil you should!
● Ends Oil Waste and Messy Floors—Costly oil is double screened and re-used again and again.
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The easy-to-carry RIDGILR comes complete with a screened chip pan, circulating oil reservoir and hose-connected hand pump-gun. See it . . . buy it at your local Supply House. You'll be glad you did!
Costs Only $23.20
with 2 gallons of RIDGID Thread Cutting Oil!
RIDGID DARK THREAD CUTTING OIL
RIDGILR BY RIDGID
RIDGID Dark and Nu-Clear Thread Cutting Oils are available in convenient (4 ounce Nu-Clear only), 1 quart, 1 gallon, (2 gallon Nu-Clear only), 5 gallon, 30 gallon and 55 gallon containers.
RIDGID
The Ridge Tool Company, Elyria, Ohio, U.S.A.

Plastics pipe standard revised

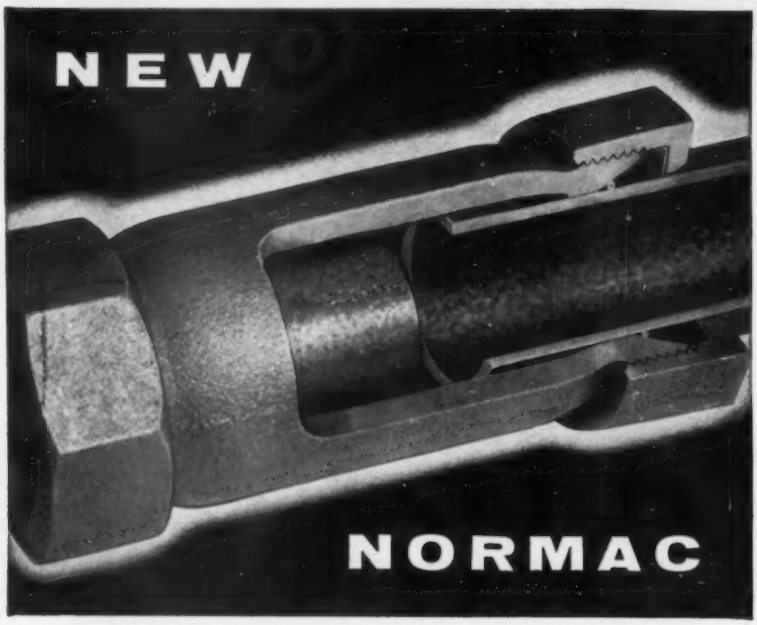
A new edition of the Commercial Standard for PVC pipe is now available. It is titled Rigid Unplasticized Polyvinyl Chloride Pipe (CS207-60).

The revision provides requirements and methods of test for materials, dimensions, workmanship, chemical resistance, brittleness, and minimum burst pressure for two types of PVC pipe. It also sets forth the standard commercial sizes and tolerances and furnishes a means of declaring compliance with the Commercial Standard.

Copies may be purchased from Superintendent of Documents, U. S. Government Printing Office, Washington 25. Price: 10 cents.

Going up

Brooklyn Union's president John Heyke (left) checks plans for company's new 14-story headquarters with Brooklyn Borough president John Cashmore. An imposing addition to Brooklyn's rapidly developing new civic center, the structure will be ready for occupancy early in 1962.



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Engineered in line with latest data on distribution pressures and installation ease. Inspect its construction and quality materials in detail. (Available with Normac INSULATING gaskets).

BRASS FITTINGS
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INSULATING GASKETS
SELF-LOCKING JOINTS
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METER BARS
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Maximum stab. All sizes, with or without insulating gaskets. Also in brass 1¼ I.P.S.

BRASS FITTINGS
The most complete line for copper or plastic tubing in ⅝, ⅞, 1⅛, 1⅜ O.D., 1¼ I.P.S.

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Get helpful CATALOG 12. Photos, specs, detail drawings & much helpful data for modernizing or new installations.

PERMANENCY Rely on NORTON-McMURRAY for the finest! NORMAC continues to modernize and improve couplings and fittings in step with latest gas distribution demands. 22 years experience concentrated on ONE purpose . . . the BEST! Today, major gas distribution companies say "NORMAC" to define their standard of quality.

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NI-Gas will boost its service area

Northern Illinois Gas Co. is launching an area development program in its 20-county service territory.

NI-Gas president Marvin Chandler said company executives will work with civic leaders in the nearly 300 communities the company serves. The program not only will place added emphasis on industrial recruitment. It also will be designed to aid the expansion of existing industries in the area.

Names representative

Controls Co. of America, Schiller Park, Ill., has appointed Automation Sales Co. as its New England sales representative. Automation Sales headquarters in Rockland, Mass.

Name changed

Brooks Instrument Co. Inc. is the new name of Brooks Rotameter Co., Lansdale, Pa.

corrosion • *Continued from page 21*

tric current divides among all of the available paths, in amounts inversely proportional to their resistances. The effect of this is that, if one path has a resistance which is a great deal less than any of the others, it will carry almost all of the current; the small remainder may escape notice, or may not be important. The danger in this false belief comes to light when someone provides a good, low-resistance path for a current and then assumes that it is so low that all or nearly all of the current will follow it.

An interesting example of this once came to my attention. Some welding was being done on board a large steel ship, using welding machines which were installed ashore. Contrary to regulations in an operating manual, the negative terminals of these machines were "grounded" by being connected to the water piping ashore. One can hardly blame the operators for this breach of the rules, however, for the two terminals of the machine were marked, not "plus" and "minus," but "electrode" and "ground."

However, in order to "complete" the circuit, and give the return current a good low-resistance path back to the machines, the hull of the ship was connected to the terminals of the welding machines, using a *250,000-cm cable*. Without any tests or calculations, it was assumed that this cable—far larger than the positive or electrode lead —was large enough to insure that the return current would flow through the cable, and not through the salt water in which the ship was floating. Measurements made during a test showed that approximately 65 per cent of the current was actually returning via the cable provided — but the 35 per cent which was returning via the salt water was enough to do an appreciable amount of damage to the steel hull at the points where it was flowing to the water. No, electricity does not always follow the path of least resistance.

(6) Copper is the best commercially available conductor. This one, and some of its implications, will be discussed next month. ■

LOW AND NARROW!

Parsons® 77 Trenchliner®

It's not much wider than a yardstick...

. . . only 4 feet wide, to be exact! What's more, this new 77 is just 5 feet-8 inches "low" with the boom in digging position. It only weighs about 6800 lbs., for convenient trailer-transport from job to job.

Trench depths to 5 feet

Small in size, but big in capacity, Parsons 77 has a work range that will surprise you. It produces from 4.4 inches to 21 lineal feet of trench per minute, in 32 hi-lo digging speed selections. You get trench widths from 6 to 18 inches — *and maximum digging depth of 5 feet!*

The tiny 77 is heavy-duty in every respect. It has positive down-crowd on telescopic ladder boom. Self-cleaning, cast steel buckets have self-sharpening removable point-type teeth. Shiftable conveyor is instantly reversible for controlled discharge. Compact and maneuverable, the 77 turns within its own length — each crawler is independently driven, independently braked. Better check what this small utility Trenchliner can do on your service lines, small mains, footings, etc. Ask Parsons distributor for demonstration, or write to us for literature.

A big, expensive rig isn't needed to transport this little 77 Trenchliner from job to job. Its low height and weight of only 6800 lbs.—permit fast one-man trailer loading—hauling under low overhead clearances. (Big ladder and wheel-types are also available.)

Mail to: PARSONS Company, Newton, Iowa *for literature on 77 Trenchliner*

NAME..... TITLE.....

COMPANY..... DIV.....

STREET.....

CITY..... STATE.....

P2I GAS

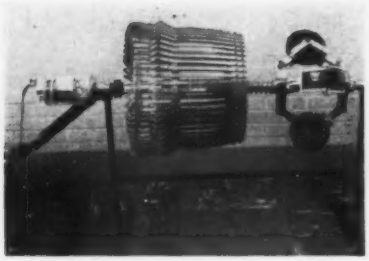
PARSONS COMPANY (Division of Koehring Co.)

Mfrs. of: TRENCHLINERS SHAWNEE® BACKHOES, LOADERS, BLADES

GAS DIGEST

New Products and Trade Literature

For more data on any of these items use the Readers' Service Card on pages 81, 82



1. Pipeline caliper

UGC Instrument's internal pipeline caliper gives a clear, concise record of the condition of the inner wall of a pipeline (GEC-650).

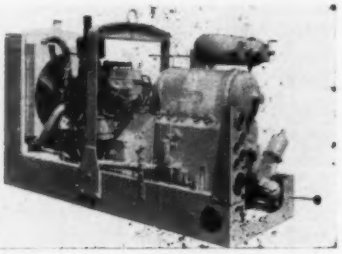
A system of probes drives a stylus on a pressure-sensitive chart to produce the record. The instrument covers pipe sizes from 4 in. through 30 in.

UGC Instruments

3. Maintenance bodies

Powers American has added Series 460 and 460-EC to its line of truck bodies (GEC-790). All tools are carried in special compartments and in the 51-ft by 96-ft body cargo area. On Series 460 (shown) optional air compressor can be installed between truck cab and body head panel.

Powers-American Division



5. Rotary compressor

Davey's Model 125-RP utility skid rotary compressor is for cross-mounting behind cabs on motor trucks (GEC-010). It is said to be dimensionally smaller, more compact and lighter than other machines for across-truck use. Featured is curb-side location of all controls, gauges, etc.

Davey Compressor Co.

2. Computer control system

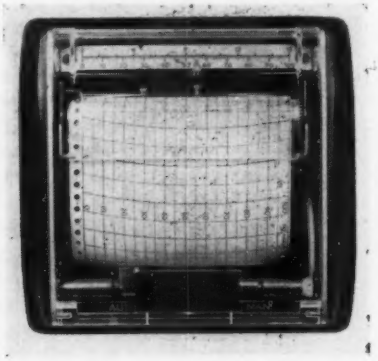
Heart of Honeywell's integrated computer control system is the company's 290 digital computer (GEC-180). This is reportedly the first system by a single company to combine instrumentation from primary elements to final controls. Designed for a wide range of uses, including gas transmission.

Minneapolis-Honeywell

4. Gas line probe

Impacto Tools' Super-30 gas line probe is a precision-made tool for testing for gas leaks (GEC-465). Only one man is needed to operate the probe. It weighs approximately 9½ lb. According to the manufacturer, connections can be made for explosion test meter to tube rod.

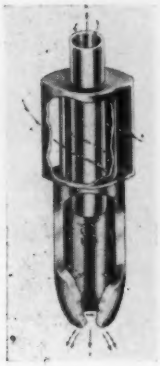
Impacto Tools



6. Remote control station

A remote control station contains all panel-mounted components needed for pneumatic cascade control of a process (GEC-750). Using two Model 58 Consotrol controllers, the cascade station receives measurements from two different points in the process, recording them on the same chart.

Foxboro Co.



7. Dry scrubbers

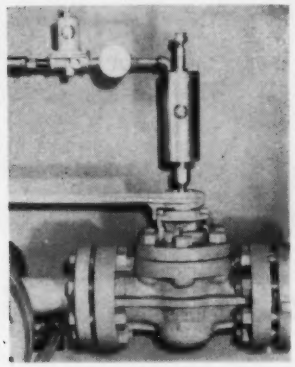
A new line of dry scrubbers removes dust and liquid from gas lines (GEC-720). The Peerless scrubbers use multiple cyclones to achieve high efficiency removal of dirt and liquid. They are available in a complete range of sizes and working pressures. Also available are compartmented scrubbers to handle widely varying flows with only one vessel.
Peerless Manufacturing Co.

8. Data transmission

New data transmission multiplex equipment can transmit 62,000 characters per second over a microwave relay system (GEC-140). Such systems would be used to transfer data between computer centers or from gathering points to computer location. Motorola's new equipment uses a single wide band subcarrier channel to achieve the high-speed transfer.
Motorola Inc.

9. Prod bar

Agra's soil resistivity prod bar has a replaceable head, assuring longer life (GEC-110). The single bar has two electrodes. A ½-in. round section of tough steel is used for all but the bottom few inches of the shank. This permits easy entry into the hardest of soils (including rocky soils) without impacting or hammering.
Agra Engineering Co.

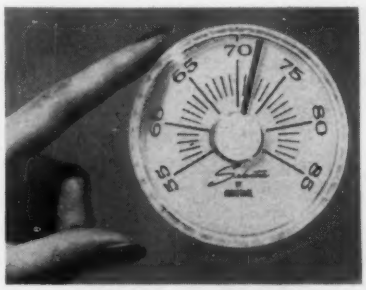


10. Valve lubricator

An automatic valve lubricator provides lubricated plug valves with a continuous and regulated supply of lubricant (GEC-820). Rockwell's automatic pressurized lubricator is particularly applicable for remote valve installations where controlled and automatic lubrication is a necessity. Since the lubricator is adjustable, there is no waste.
Rockwell Manufacturing Co.

11. Leak detector

Extremely small leaks are easy to locate with Calgon gas leak detector (GEC-465). The detector is a high-viscosity liquid which forms bubbles when daubed on pipe joints where leakage is suspected. Leaving no deposit, harmless to skin, and non-staining, the liquid can be used with safety and without danger of fire. It comes in 6-oz unbreakable bottles.
Calgon Co.



12. Combination control

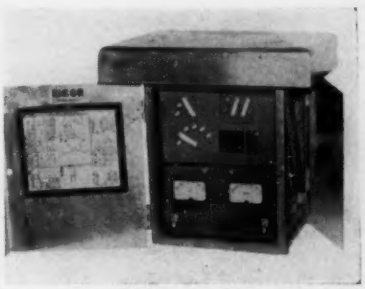
A new combination wall control is available for electronic modulation systems used on gas furnaces (GEC-190). Maxitrol's Selectra modulation system no longer needs a separate thermostat to act as end switch. Thermostatic function now is incorporated in the wall control with the addition of a bi-metal thermostat.
Maxitrol Co.

13. Dewpoint recorder

A dewpoint recorder automatically and continuously measures, indicates, and records moisture contents of gases (GEC-670). Model W-C can be used for such control functions as proportioning, on-off switching, alarm signaling of high or low dewpoint. Available with standard electric or pneumatic control systems, it records on either round or strip charts.
Weighing & Controls Inc.

14. Data processing

IBM has announced its advanced solid-state IBM 7074 data processing system (GEC-180). The 7074 is twice as fast processing business data and is up to 20 times as fast in scientific computations as its related 7070 system. Easily convertible, the major change is the replacement of the three 7070 modules with two high-speed 7074 components.
IBM Corp.



15. Cathodic protection

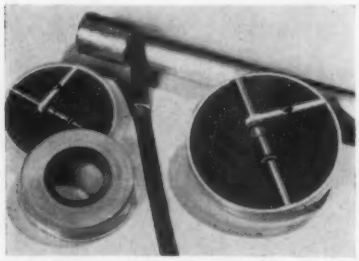
Eicor's one-unit cathodic protection rectifiers come in four standardized case sizes (GEC-110). The 11-gauge steel cases may be pole or platform mounted. Wide swinging doors give easy access to equipment panel. Transformers are custom-designed and manufactured with sufficient safety factor for intermittent overloads.
Eicor Div.

16. Gas chromatograph

Loe's programmed-temperature gas chromatograph permits column operation from ambient to 500 deg C (GEC-670). Two symmetrically heated columns are used in Model 17. One is for analysis, the other discharges through the reference detector for column vapor pressure compensation. High stability is achieved by the use of the two columns.
Loe Engineering Co.

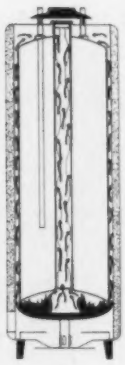
17. Baking, roasting oven

Keating's Wimco oven has received approval from the AGA Labs (GEC-230). This oven offers new concepts in baking and roasting, and is an illustration of inter-industry cooperation in research. According to Keating, the oven has set new records for roasting meat with minimum shrinkage and for baking at greatly accelerated speeds.
Keating of Chicago Inc.



18. Dry seal for pipe

A new line of Teflon tape is for dry sealing all types of threaded pipe joints (GEC-730). It can be used in hydraulic, compressed air, vacuum, and steam lines, etc. The complete sealing job is done by wrapping the Teflon tape material around the pipe threads. Time-consuming clean-up around the thread is not necessary. "Wrap-It" comes in ½-in. widths.
Hitemp Wires Inc.

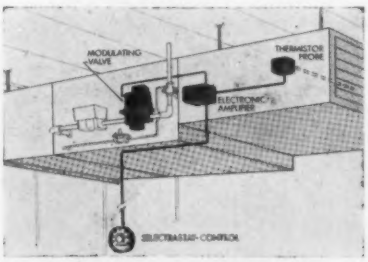


19. Waterheater

A 127 per cent boost in recovery capacity has been achieved in Hotstream Heater Co.'s new J-40 water heater (GEC-860). A combination internal-external flue construction provides greater exposure of heat transfer surface area. The 40-gal. automatic storage type heater has a recovery rate of over 1 gal. per minute raised 100 deg F.
Hotstream Heater Co.

20. Warning flags

A new line of fluorescent danger flags is for street, highway, and plant use (GEC-710). The brilliant flame red fluorescent vinyl is permanently bonded to both sides of the nylon base fabric. The flags come in a complete range of sizes and styles for use on sign and flag standards, barricades, traffic cones, trucks and trailers.
Pendergast Safety Equipment



21. Make-up air control

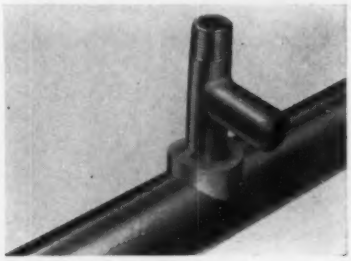
Maxitrol has introduced a new electronic modulation system for gas-fired duct heaters used in make-up air systems (GEC-190). The system eliminates many of the problems of make-up air introduction into public halls, theaters, restaurants, etc. Varying outdoor temperature differentials are met by a continuous flow of varying temperature air.
Maxitrol Co.

22. Roll-up ladder

A new 12- and 16-ft aluminum ladder rolls up into a compact bundle so it can be carried like a suitcase or transported in the trunk of a compact car (GEC-770). When unrolled and locked in position, Aladdin's ladder becomes rigid and handles like a conventional straight ladder. It will easily support a load of 1000 lb in the ladder position.
Aladdin's Products Inc.

23. Pushbutton units

A complete line of miniature industrial oil-tight pushbotton units permit at least a 40 per cent reduction in panel space requirements (GEC-200). Because of their smaller size, the new units may be mounted as close as 1¼ in. apart. Included are six different colored retaining rings to permit easy changes in color coding.
General Electric Co.



24. Punch tee

A new punch tee has been added to the Thermotap line of service connections (GEC-370). Tees have a high strength, cast steel body with ¾-in. base. After Thermotap connection is made, a hardened ⅜-in. punch is screwed into tee until pipe is pierced. Punch is then unscrewed until its top end is flush with the top of the tee casing.
Continental Industries Inc.

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25. Valve lubrication

Rockwell's automatic lubricator for lubricated plug valves is covered in a new bulletin (GEC-820). The booklet shows construction details, tells how to install and operate the lubricator, and gives information necessary for the device's adjustment.
Rockwell Manufacturing Co.

26. Pipeline compressors

Mechanical and hydraulic design considerations for two-stage centrifugal pipeline compressors are presented in Clark's Bulletin 187 (GEC-160). The discussion outlines growth in compression ratios of pipeline boosters from 1.10 per impeller to ratios of 1.50 per impeller and higher.
Clark Bros. Co.

27. Lightweight piping

Expanded size range for Tube Turns' taper-face flanges is covered in Bulletin TT942 (GEC-370). The bulletin lists four-way savings obtainable with lightweight carbon steel piping.
Tube Turns Div.

28. Gas regulator film

Essential elements of gas regulators are covered in a new sound and color strip film from Fisher Governor (GEC-700). The film, using cartoons and diagrams, may be projected either automatically or manually. Presented in two parts, the running time is about 30 minutes.
Fisher Governor Co.

29. Orifice meter stations

Bulletin MS-1 from Daniel Orifice describes packaged orifice meter stations (GEC-560). Discussed are portable and permanent stations the company has available for wellhead gas metering, city gate sales, power plants, or transmission installations.
Daniel Contract Div.

30. Ductile iron valves

A new bulletin from Crane discusses its new line of ductile iron gate valves (GEC-820). The valves are available in sizes from 2 in. through 12 in.
Crane Co.

31. Flowmeter

"Simple Talk About a Simple Flowmeter" discusses the new vortex-velocity principle of fluid flow measurement (GEC-560). Also discussed is Rotron's line of Whirlflo Flowmeters, based on this principle.
Rotron Controls Corp.

32. Pipe taping manual

Safe-T-Clad has published a field manual covering all phases of construction techniques and the costs of applying polyethylene tape (GEC-130). Presented is a comparison between polyethylene tape methods and hot coatings on over-the-ditch construction.
Safe-T-Clad Div.

33. Line pipe specs

Youngstown's new brochure outlines specifications and other facts about the company's line pipe (GEC-620). In addition to technical matter, the 8-page brochure contains a graphic description of the three methods by which Youngstown makes line pipe—continuous weld, seamless, and electric weld.
Youngstown Sheet & Tube

34. Pneumatic controllers

Series 624 indicating pneumatic controllers from Bristol are covered in Bulletin DM058 (GEC-200). Specifications for the instruments are given and models are listed for controlling pressure, vacuum, liquid level, flow, temperature, and humidity.
Bristol Co.

35. Small trencher

A small, compact, tough trencher for city and suburban work is described in a new 12-page folder (GEC-210). Cleveland's Model 92 is covered in brief copy and action photos in Bulletin L-108.
Cleveland Trencher Co.

36. Industrial telemetering

An 8-page brochure describes ASOP industrial telemetering equipment (GEC-750). The brochure shows typical line costs and line capacities, tells how the telemetering system works, and outlines typical systems.
ASCOP Division

37. Talking 'computerese'

Aware of the baffling technical jargon surrounding "electronic brains," Minneapolis-Honeywell has published a pocket-size, 22-page glossary defining some 82 terms (GEC-180). The booklet, "Do You Talk 'Computerese?,'" should make computer language more intelligible to the layman.
Minneapolis-Honeywell

38. TV commercials

Information is available on a series of eight animated commercials using the Speedy Therm character (GEC-550). Each commercial extolls the advantages and salient features of a different gas appliance, and is adaptable to 10-, 20-, and full 60-second spots.
Speedy Therm

39. Multiplex-carrier

Bulletin ECM covers G-E's new transistorized multiplex-carrier equipment, engineered to transmit from 1 to 600 full duplex toll quality voice channels over a single radio beam (GEC-140).
General Electric Co.

40. Closed circuit TV

"What Every Businessman Should Know About Closed Circuit TV" is the title of a booklet explaining industrial and commercial TV in layman's language (GEC-140). Lightly written with a serious intent, the booklet covers many basic applications.
GPL Division

41. Industrial combustion

Every type of burner, mixer, pilot, regulator, blower, valve and accessory made by Bryant is presented in an 8-page catalog (GEC-400). The condensed catalog of gas-combustion and control equipment gives data on size range, capacity, and application of more than 55 products.
Bryant Industrial Products

42. Control equipment

Accessories and special control equipment are covered in Catalog 57-S7 from Automatic Switch (GEC-200). Among items described is a relay panel for gas valves.
Automatic Switch Co.

GAS • PEOPLE

CHARLES T. KLEIN has been elected a vice president and director of Cities Service Gas Co., Oklahoma City. Klein has been manager of the natural gas division of Cities Service Oil Co. (Del.) at Bartlesville, Okla., and a member of that company's board.

Several changes are announced by Niagara-Mohawk Power Corp., Syracuse. BURT G. JESMAIN, formerly superintendent of the gas department for the Syracuse area, is now Utica area superintendent. ARTHUR P. RICH is assistant superintendent in charge of gas operations in Syracuse. He formerly was distribution foreman in the Syracuse gas department. LEO P. MORRISSEY is now manager of the Cattaraugus district.

WALTER A. HUSSING is lease and right-of-way agent of Peoples Natural Gas Co., Pittsburgh. With the company since 1940, Hussing has held various posts in the lease and ROW department.

Charles Klein
Cities Service

W. A. Hussing
Peoples Nat.

FRANK C. L. SPERRY and EDGAR M. HAWKINS JR. are newly elected vice presidents of Stone & Webster Service Corp., New York. Sperry also was elected president of Conversions & Surveys Inc., a subsidiary. Before joining Stone & Webster in 1947, Sperry was with Blackstone Valley Gas & Electric Co., Atlanta Gas Light, and Peoples Gas Co. Hawkins served as executive vice president of Michigan Gas Utilities Co. from 1957 to 1959, when he returned to Stone & Webster, which he first joined in 1933.

As part of its stepped-up foreign marketing program, Grove Valve & Regulator Co., Oakland, Calif. has named ERNEST H. RETTIG as its first full time sales and service representative for South America. He will headquarter in Houston. Rettig formerly was with El Paso Natural Gas Co. The company also announces the appointment of AL ROMANO as sales engineer in southern Louisiana. He will headquarter in Lafayette.

MRS. MARY RUTH FORBES has been promoted to home service director for the Texas distribution system of United Gas Corp. She formerly was home service advisor in the Houston division.

E. T. Hollifield
Atlanta Gas

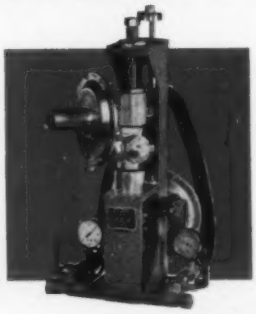
George Adams
Atlanta Gas

UNIVERSAL

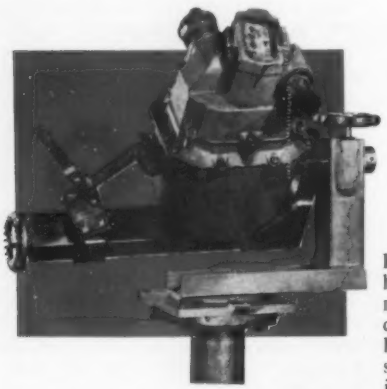
Time and Labor saving equipment for regulator and meter maintenance

REGULATOR REPAIR AND TEST STANDS

This dual-purpose shop fixture serves as a vise to securely hold regulators of any make in a fixed, convenient position for repairing and testing. New regulators are tested, made ready and set for service in less than one-fourth the time usually required. Hundreds in use throughout the United States and Canada. Saves countless hours and labor . . . assures better repairs and precision settings.



Type 480 Universal Regulator Repair and Test Stand. Complete information in bulletin No. 570.



Type 500 Universal Meter Repair Rack. Ask for completely illustrated bulletin No. 570.

METER REPAIR RACKS

Bench or pedestal mounted rack for holding hard-case meters in a "cradle", rigidly locked between rubber-faced clamping blocks. "Cradle" rotates both horizontally and vertically, and may be securely locked in any fixed position for inspection or repair. Repairman's hands are free for easy manipulation of tools or instruments. Used for over ten years in shops in all sections of U.S. and Canada.

UNIVERSAL CONTROLS CORPORATION

OFFICE AND PLANT • CARROLLTON, TEXAS
Mail Address • P. O. Box 13122 • Dallas 20, Texas

E. H. Rettig
Grove

Al Romano
Grove

E. T. HOLLIFIELD has been named Macon, Ga. manager of Atlanta (Ga.) Gas Light Co. At the same time, GEORGE W. ADAMS was named operating superintendent in Atlanta. Other appointments include: FRED E. NEELEY, production and building superintendent in Atlanta; P. C. AVANT, chief engineer; JOHN E. LESTER, Macon superintendent; W. F. BENNETT, assistant chief engineer; THOMAS C. BUSH, Augusta superintendent; JOHN D. ROBERTS, Athens superintendent; JOSEPH S. HORNSTON, assistant service superintendent; STANLEY G. WOOD, executive assistant; WILLIAM F. NORMAN, Atlanta division engineer; and WILLIAM T. RAINES, Waycross superintendent.

FLOYD GAUNT, a veteran of almost a half century in the gas industry, has retired as vice president and general manager of Reynolds Gas Regulator Co., Anderson, Ind. He will remain as a consultant to the firm. ROBERT E. WELLBORN succeeds Gaunt as general manager. Gaunt joined Reynolds in 1920 and became vice president and assistant manager in 1926. He was made general manager when Arkansas Louisiana Gas Co. purchased Reynolds in 1958. Wellborn comes to Reynolds from the post of gas distribution engineer in the Arkansas division of Arkansas-Louisiana Gas Co.

Floyd Gaunt
Reynolds

R. E. Wellborn
Reynolds

OIL FOG

Two Koppers Cold Foggers arranged for single or parallel operation with automatic control. This is one of two gate station installations serving the City of Clearwater, Fla. Each provides a total maximum fogging capacity of approximately 3 gallons per day.

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Koppers Cold Foggers are available as stock items in capacities as low as 1 gallon per day. Hot Oil Foggers for gas, steam or electric heating, are made in a wide range of capacities, as much as 200 gallons per day. For full information write to: KOPPERS COMPANY, INC., Gas Apparatus Dept., 2009 Scott St., Baltimore 3, Md.

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E. D. Hoenshell
Consolidated

R. E. Garrett
U.S. Pipe

C. S. Lawson
U.S. Pipe

Jackson Kemper
Mueller

JACKSON KEMPER has joined Mueller Co., Decatur, Ill., as executive vice president. He succeeds W. H. HIPSHER, who has resigned. Kemper formerly was vice president and general manager of the Forge & Fittings division of the H. K. Porter Co.

ROBERT E. GARRETT has been elected president and chief executive officer of U. S. Pipe & Foundry Co., Birmingham, Ala. He succeeds CLAUDE S. LAWSON, who retired on Aug. 1. Lawson, president since 1952 and chairman of the board since 1954, will continue as chairman. In 1952, shortly after the merger of Sloss-Sheffield Steel & Iron Co. and U. S. Pipe, Garrett was elected a vice president of U. S. Pipe. In 1954 he became a director and member of the executive committee and in 1959 was elected executive vice president.

EMERY DEE HOENSHELL has joined the Consolidated Natural Gas System as system manager of community services. The former director of the Duluth, Minn. Industrial Bureau will carry out Consolidated's community betterment and industrial development program in Pennsylvania, West Virginia, and Ohio.

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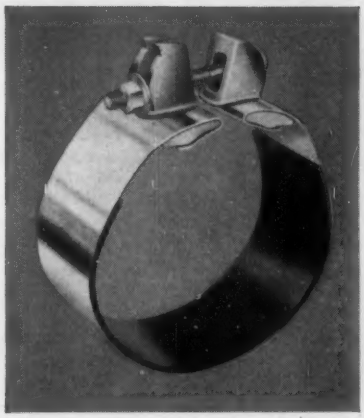

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Repair all high-pressure pipe leaks quickly, safely with this new Heavy-Duty PATCHMASTER. It's designed to conform to pipe under high torque—*without biting into the pipe!* Flexible stainless steel band is completely corrosion resistant. The synthetic rubber pad won't extrude or deteriorate and adapts the PATCHMASTER to oil, gas, water and steam piping in all industries. Cut costly equipment downtime. Have Marman PATCHMASTERS on hand. Sizes for ½" to 8" pipe.

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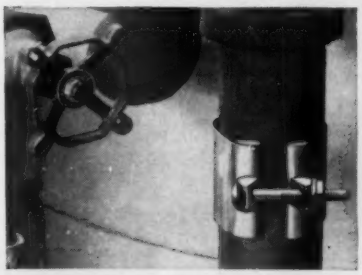
For complete information on these and other versatile Marman Products, contact your local Marman distributor listed here.



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Grayson

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Grayson

RICHARD D. HALL has been named to the new post of manager, distributor sales, for Robertshaw-Fulton's Grayson Controls division, Long Beach, Calif. For the past five years, Hall has been a Grayson sales representative in the Pacific Southwest territory. SAMUEL D. HOUSTON is the newly appointed district sales manager of Grayson's southern territory, headquartering in Chattanooga, Tenn. FLOYD FOSTER replaces Houston as a sales representative in the Dallas office.

JOHN I. RUDGE has been named to the newly created post of executive vice president in charge of marketing for Carlon Products Corp., Aurora, Ohio. He will be in charge of sales and marketing activities of Carlon plastics pipe and related products. Rudge formerly was vice president in charge of Carlon's southeastern district at Asheville, N. C.

PARKER S. ANDERSON has been appointed development engineer at the Vulcan plant of Reeves Brothers Inc. in Buena Vista, Va. Most recently, Anderson was with the Superior Meter division of Neptune Meter Co. Before that, he was superintendent of meters with Michigan Consolidated Gas Co.

JOHN P. ROCHE, president of Heppenstall Co., is a new director of Manufacturers Light & Heat Co., Pittsburgh.

Floyd Foster
Grayson

John Rudge
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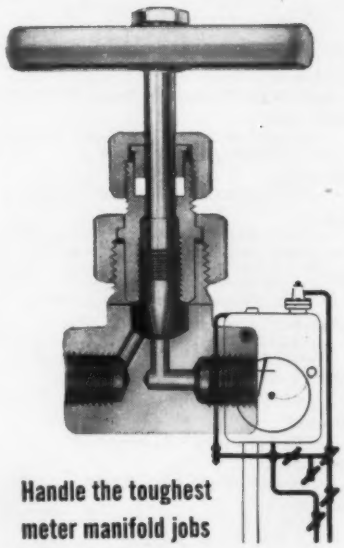

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Standard valves are design rated for pressures to 5,000 psi at 70°F. Upon request, assembled valves are hydrostatically tested to 10,000 psi (twice rated working pressure) and individually inspected. Valves are also furnished with graphite-impregnated asbestos packing for temperatures above 450°F.

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General Offices:
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HESTER C. MOUNT is the new manager of Southern Union Gas Co.'s Port Arthur (Texas) district. He succeeds JOHN H. PRITCHARD, who has retired. Port Arthur operations include Griffing Park, Groves, Lakeview, Nederland, Pear Ridge, Port Acres and Port Neches. Pritchard, in the gas industry for 41 years, became affiliated with Southern Union when the company acquired Texas Public Service Co. in 1949. J. B. MORELAND is the newly named sales manager for the Port Arthur district. Formerly, Moreland was dealer sales coordinator in Austin.

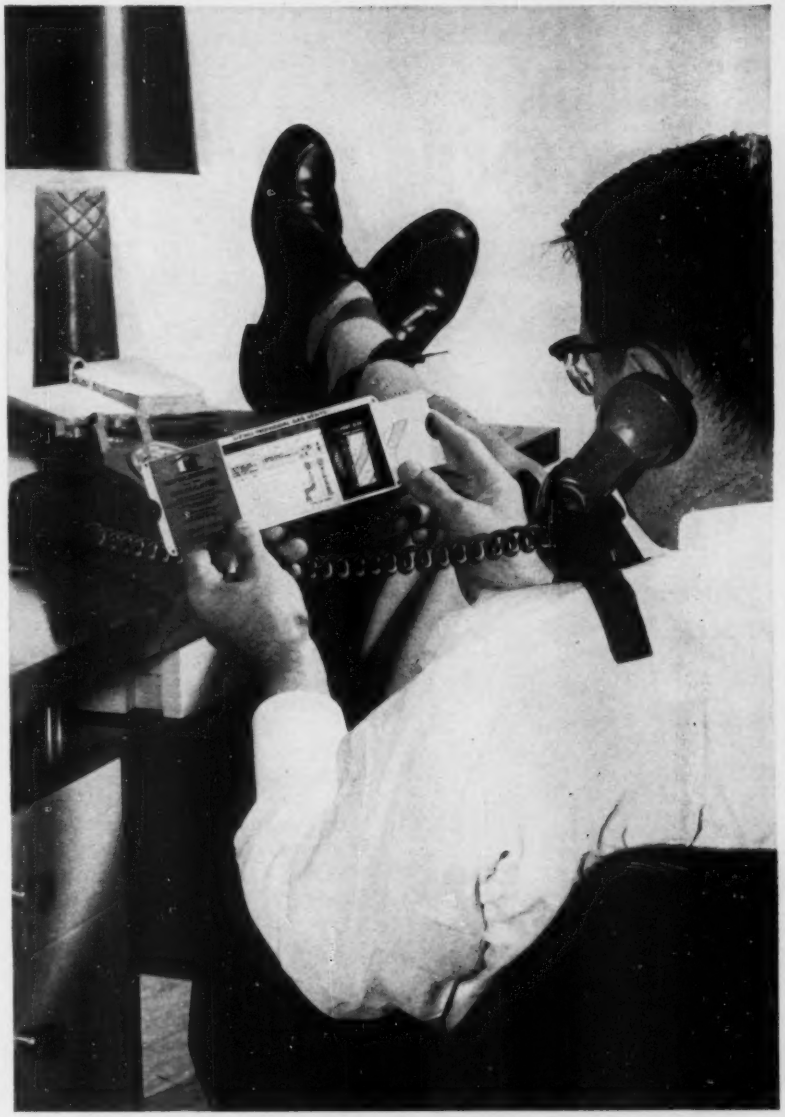
Several changes are announced by South Jersey Gas Co., Atlantic City. ELTON E. STUENCKEL is director of marketing, in charge of planning and administering all residential and commercial sales, merchandising, dealer relations, and advertising and sales promotion programs. He is succeeded as sales promotion and advertising manager by JOHN R. MCWILLIAMS. McWilliams has been supervisor of advertising for the past four years. JAMES B. SHIVER was promoted from supervisor to manager of public and employee relations.

Several home service advisors have been appointed by Ohio Fuel Gas Co. MRS. NANCY ELIZABETH HUGENBERG and MRS. NAN PHILBY HORN will work in the Columbus area, while BRENDA BURRIS will be home service advisor in Newark.

DR. VAN W. BEARINGER has been named director of research for Minneapolis - Honeywell Regulator Co. Named assistant directors are DR. JOHN N. DEMPSEY and EDWARD E. REXER. Dr. Bearinger, formerly associate research director, will supervise the expanding activities of Honeywell's research center in Minneapolis.

ROBERT W. ALLISON has joined Kraloy Plastic Pipe Co., Santa Ana, Calif., as manager of advertising and public relations. Allison formerly was with Radio Corp. of America and the National Direct Mail Corp. in Montreal.

JOHN VAN DYKE has been named to the newly created post of automation engineer for Columbia Gas System Service Corp. in Marble Cliff, Ohio. For the past year, Van Dyke has served as electrical design engineer for Columbia Gulf Transmission Corp. in Houston.



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The Kit repairs holes, splits or breaks in pipe, valves and fittings.

Write for solutions to your specific problems.

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W. E. LONG is sales manager of Houston (Texas) Natural Gas Corp. Long has been assistant to the president for the past five years. In his new post, he will have supervision over all sales to residential, commercial and industrial customers.

CHARLES L. WALKER is district office manager of United Gas Corp.'s Biloxi, Miss. office. He succeeds E. C. BATTON JR., who has been temporarily assigned to the company's general offices in Shreveport.

Two new sales representatives have been named by American Meter Co. EDMUND B. LENNIG will work in the San Francisco sales district and RONALD M. ROBERTS will cover the Atlanta sales district.

Deaths

EARL G. FRANK, 56, secretary of Milwaukee (Wis.) Gas Light Co. Frank was with the company for 27 years, and has been an officer since 1957.

CLYDE WILLIAM FAULKNER, 41, general manager of Bluefield (W. Va.) Gas Co. Faulkner also had served as general manager of Gas Service Inc.

HARRY N. STROTHMAN, 42, Chicago regional sales manager for Royston Laboratories Inc., Blawnox (Pittsburgh), Pa. Before going to Chicago, Strothman held a similar post in the eastern U. S.

EUGENE H. BIRD, president of Eastern Gas & Fuel Associates. Bird was with Eastern Gas since its organization in 1929, for the past 15 years as president. He was also a director of subsidiaries, including Boston Gas Co. Bird also served as a director of Algonquin Gas Transmission Co.

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Engineering degree with at least two (2) years experience in the industrial, commercial and central house heating, air-conditioning and miscellaneous appliances, covering gas sales, engineering, supervisory installation and service. Must be thoroughly experienced in preparing heating and air-conditioning surveys and selling gas equipment for the promotion of gas sales, on the Northwest gulf coast of Florida. Starting salary, $496 ranging to $598 per month. Maximum age—35. Send full resume. Box 910, GAS Magazine, 198 S. Alvarado St., Los Angeles 57, Calif.

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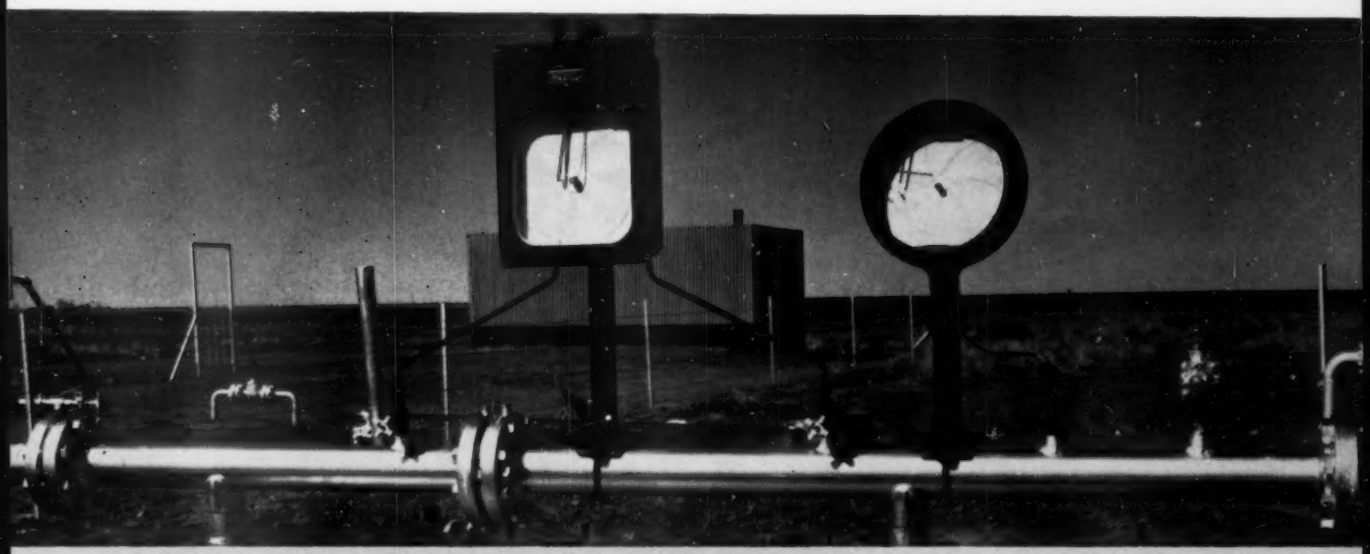
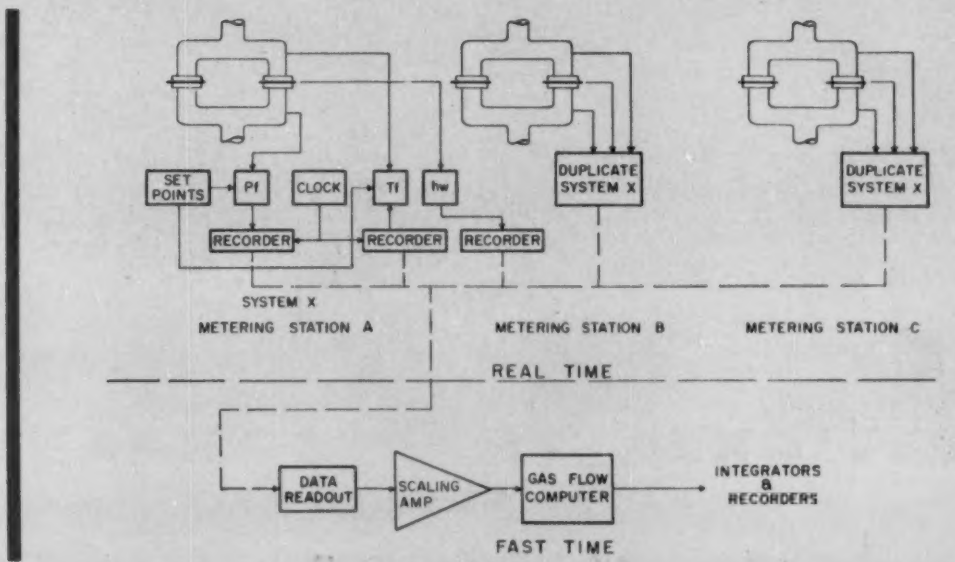
PIPELINE SECTION



Computer for automatic gas flow compensations



NATIONAL'S Revolutionary MANI-FLO® VALVE

PATENT APPLIED FOR

The MANI-FLO valve, through unique design, lends itself to wide use in the production of oil and gas. Designed primarily for use in lease well production manifolds to eliminate the problems and expenses of conventional arrangements consisting of cumbersome piping, standard valves and fittings, it may also be used as a three-way valve for blending two streams for temperature control; for mixing two different liquids or gases; or as a switching valve to divert flow to different tanks or lines.

In any role or application, MANI-FLO valves may be hydraulically, electrically or diaphragm controlled and sensed by liquid levels, pressures, temperatures, times or differentials of these.

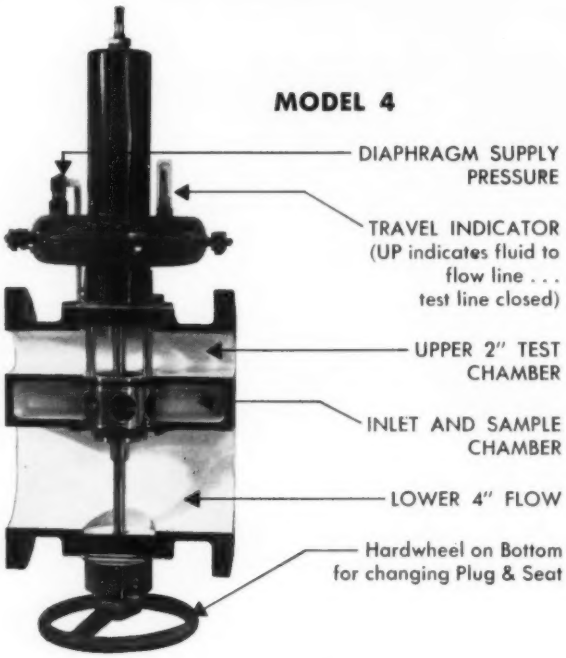
MANI-FLO valves may be installed in a horizontal line with diaphragms and/or handwheels either vertically or horizontally, or valves may be stacked vertically from ground up with controls pointing in any direction.

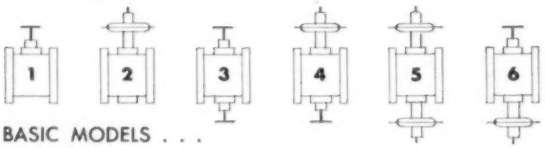
TYPICAL SPECIFICATIONS:

SIZE: 2" screwed inlet — 2" test outlet — 4" flow outlet — ½" sample connection opposite 2" inlet.

WORKING PRESSURE: 600 PSI. Test Pressure 1200 PSI.

MATERIAL: Body and Body Cover Flanges — Ductile Iron. Diaphragm Case — Pressed Steel. Plug, Seat and Cage — Type 303 Stainless Steel. Plug has Buna N synthetic rubber molded to 303 to give same sealing characteristics as "O" ring for tight shut-off. Metal-to-metal contact between plug and seat to prevent extrusion of rubber and to take excess force applied to seat and plug when closed.


MODEL 4
DIAPHRAGM SUPPLY PRESSURE
TRAVEL INDICATOR (UP indicates fluid to flow line . . . test line closed)
UPPER 2" TEST CHAMBER
INLET AND SAMPLE CHAMBER
LOWER 4" FLOW
Hardwheel on Bottom for changing Plug & Seat



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  - a. May be used as a shut-in valve
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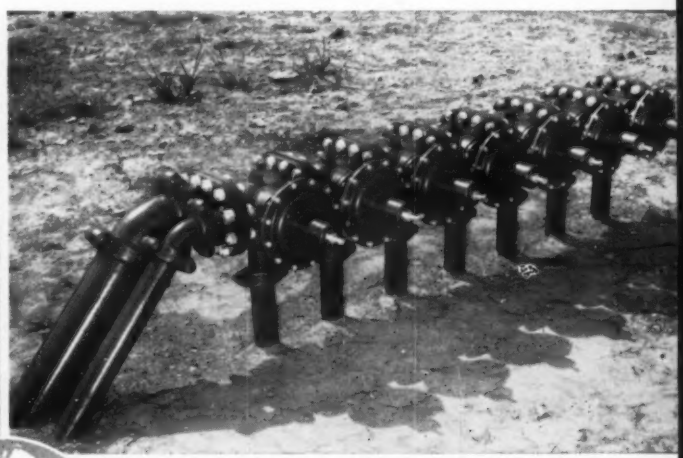
- LONG-LASTING SAFETY . . . ductile iron bodies with stainless trim, tested to 3,000 PSI
- ACCEPTED AND APPROVED . . . hundreds in use already
- LOOKS THE PART . . . Judge for Yourself!



For prices and more information, state model number and quantity. Address . . .

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DRAWER 1710

TULSA, OKLAHOMA

A computer for

Automatic gas flow compensations

By F. P. SIMMONS, Staff Scientist
Link Division, General Precision Inc., Binghamton, N. Y.

THE orifice measurement of gases has been accepted and practiced by large consumers for many years. Although the state of the instrument art has advanced through these years, the general acceptance of other methods of gas measurement, in large volume, has not been forthcoming.

There are advantages to the continued use of orifice measurement if you consider the capital outlay that is required to change existing metering station runs to accommodate more recent measurement devices. In one large gas company, such a change would not be considered until it was necessary to retire their present orifice metering installations due to age.[1] Then, only when the alternative measurement device would permit the same dynamic range of 20:1 that exists in most installations, would the change be practical.

There is also the readily apparent advantage of continuing to use orifice metering techniques in order to maintain a high degree of transmission flexibility without sacrificing the dynamic range over which the system must operate with essentially linear characteristics. Although the dynamic range, with linear characteristics, of any single orifice plate would not be 20:1, it is common practice to change plates when gas consumption varies due to seasonal changes in order to keep the average differential across the orifice within pre-set limits. When the differential exceeds this limit on a primary run, because of increased gas consumption, a secondary metering run is automatically brought into service. With two runs in service, the differential across each orifice plate is maintained within the limits of system linearity.

The sophistication of gas measurement techniques through the years is apparent when you consider that the change in gas density, as it passes through an orifice, was neglected in gas measurement prior to the early 1930's when the American Gas Association published its first Gas Measurement Committee Report. The change in specific weight, also accompanied by a change in velocity and pressure, as a gas flows through an orifice was not considered in gas measurement techniques until 1935 with the advent of the Gas Measurement Committee Report No. 2. This change was called the "expansion factor." In 1955, the third, and most recent, report was published by this committee. Basically, this report only clarifies statements in previous reports and changes the recommended base pressure from 14.4 psia to 14.73 psia. Such a stabilization in gas measurement techniques can be construed to mean that experience over 30 years, even with the availability of more sophisticated measurement instruments, has not changed the basic hydraulic gas equation for the measurement of gas quantity rate of flow in cubic feet per hour.

• Basic gas equation

Equation (1) is universally used for expressing rate of natural gas flow in cubic feet per hour referenced to standard base conditions.[2]

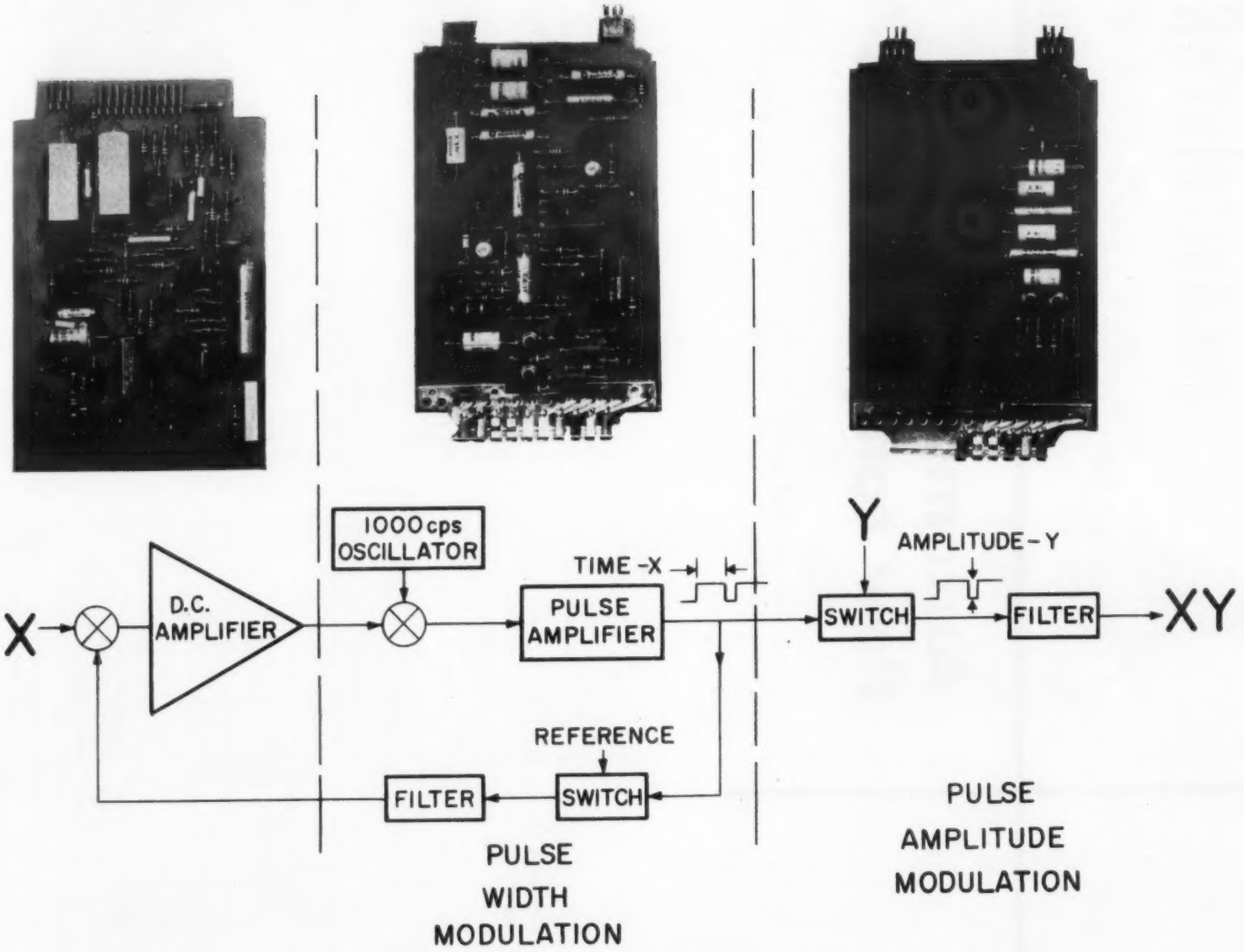


Fig. 1. Electronic time division multiplier.

$$Qh = C' \sqrt{h_w P_f} \quad (1)$$

where: Qh = quantity rate of flow at base conditions in cu ft/hr

C′ = orifice flow constant

h_w = differential pressure in inches of water at 60° F

P_f = absolute static pressure in psi.

The orifice flow constant (C′) may be expressed in two ways and is defined as the multiplier of the extension $\sqrt{h_w P_f}$ necessary due to variation from unity of the flow factors, defined below, to make Qh equal to quantity rate of flow in cu ft per hr at base conditions.

$$C'_1 = (F_1)\,(F_2)\,(F_3)\,(F_4)\,(F_5)\,(F_6)\,(F_7)\,(F_8)\,(F_9) \quad (2)$$

where: $F_1 = F_b$ = basic orifice factor

$F_2 = F_r$ = Reynolds number factor

$F_3 = Y$ = expansion factor

$F_4 = F_{pb}$ = pressure base factor

$F_5 = F_{tb}$ = temperature base factor

$F_6 = F_{pv}$ = supercompressibility factor

$F_7 = F_m$ = manometer factor

$F_8 = F_g$ = specific gravity factor

$F_9 = F_{tf}$ = flowing temperature factor

also;

$$C'_2 = 218.44\, d^2\, K \frac{Tb}{P_b} \sqrt{1/T_f G} \quad (3)$$

where: d = orifice diameter in inches

G = specific gravity of flowing gas, dry air = 1.000

K = discharge coefficient, a constant.

For base conditions of 60 deg F and 14.73 psia, equation (3) reduces to:

$$C'_2 = Ka \sqrt{1/T_f G} \quad (4)$$

and under base conditions, the factors $F_1, \ldots, F_7$ become constants so that equation (2) reduces to:

$$C'_1 = (K_b)\,(F_8)\,(F_9)$$

$$C'_1 = (K_b)\left(\sqrt{1/G}\right)\left(\sqrt{520/T_f}\right)$$

$$C'_1 = K_b \sqrt{520/T_f G} \quad (5)$$

Since equations (4) and (5) are equal with only the value of the constant in difference, we may state that:

$$C' = K \sqrt{1/T_f G} \quad (6)$$

and from (1):

$$Qh = K \sqrt{\frac{h_w P_f}{T_f G}} \quad (7)$$

Equation (3) may be solved theoretically using empirical equations to define K. The calculations are lengthy and laborious to execute and use parameters involving viscosity, Reynolds number, specific weight of the gas, and velocity of the gas through the jet.

Equation (2) may be also solved theoretically using empirical equations to define nine different orifice factors, or it may be solved by interpolation from tables prepared by the AGA.

An analysis of the three methods for one example showed the following variations:

a. Solved empirically:

$$Qh_1 = C'_1 \sqrt{h_w P_f} = 36{,}999 \text{ cu ft/hr}$$

$$Qh_2 = C'_2 \sqrt{h_w P_f} = 36{,}129 \text{ cu ft/hr}$$

b. Solved from AGA table entry:

$$Qh_3 = C'_3 \sqrt{h_w P_f} = 37{,}052 \text{ cu ft/hr}$$

c. Computer solution from (11)*:*

$$Qh_4 = K \sqrt{\frac{h_w P_f}{T_f}} = V_o \times 10^5 = 36{,}590 \text{ cu ft/hr}$$

Since each table entry in (b) may contribute as much as 0.5 per cent error, according to AGA, and there are nine separate entries, it is theoretically possible to obtain as much as a 4.5 per cent error using this method, although the nominal error will probably be in the 2 per cent range. Using either of the methods discussed under (a) gives a theoretical answer using empirical equations where initial input accuracies are unknown. If we state that from these two methods:

$$C' \text{ average} = \frac{C'_1 + C'_2}{2}$$

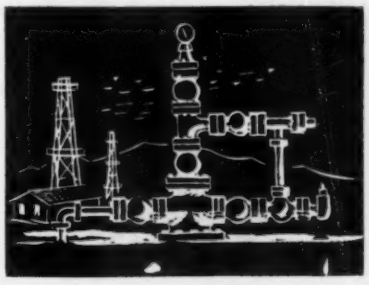
then,

$$Qh_a = \frac{C'_1 + C'_2}{2} \sqrt{h_w P_f} = 36{,}594 \text{ cu ft/hr}$$

in the given example, and from the gas flow computer,

$$Qh_4 = Qh_1 \quad -1.10\%$$
$$= Qh_2 \quad +1.27\%$$
$$= Qh_3 \quad -1.25\%$$
$$= Qh_a \quad \pm 0.00\%$$

The question that obviously arises is how much gas actually flowed through the orifice? An exact mathematical expression to define this flow does not exist, nor does the state of the instrument art permit physical measurement of exact orifice flow. Therefore, the use of empirical expressions, or tables prepared from these expressions, is necessary to express gas flow within certain limits. Since, in the natural gas distribution business, a contract usually specifies that billing will be within 2 per cent of actual flow, it would seem that equations to express this flow should agree within a limit of 2 per cent. However, they do not. In the given example, which is typical, the two empirical expressions, Qh_1 and Qh_2 are only within 2.37 per cent of each others, and Qh_3 from table entry falls about halfway between them. For the purpose of the error analysis of the present orifice measurement method, it is assumed that the equation for the Qh_a is a more exact expression of actual gas flow.



With this assumption, deviation from Qh_a in any of the methods shown above is ±1 per cent, or within a 2 per cent limit.

• Present planimeter method—error analysis

Although the above variations in gas rate of flow, found from several methods of calculations, are interesting, it is recognized that, due to their empirical nature, none of these equations represents the actual gas flowing through the orifice. Since, in practice, polar planimeters are normally used to integrate the parameters of the equations as recorded on circular charts, the calculated gas flow from this method will also vary from actual gas flow. Also, since the recorded inputs will have an initial error, from equation (7) it can be shown that the calculated Qh may have a maximum error of:

$$Qh_{cal.} = A\,(1 + E_1)\sqrt{\frac{BC}{DG}\,\frac{(1 + E_2)\,(1 + E_3)}{(1 + E_4)\,(1 + E_5)}}\,(1 + E_6)$$

where: A = discharge coefficient
B = differential pressure
C = static pressure
D = temperature
G = specific gravity
E_1 = error in empirical equations which define A.
E_2 = error in initial measurement and recording of B
E_3 = error in initial measurement and recording of C
E_4 = error in initial measurement and recording of D
E_5 = error in initial measurement and recording of G
E_6 = planimeter machine error plus error of human operator in tracing the recording.

Neglecting higher than first order magnitudes of E, the error equation reduces to:

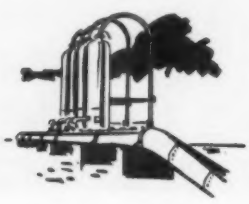
$$Qh_{cal.} = A\sqrt{\frac{BC}{DG}}\,(1 + E_1)\left(1 + \frac{E_2}{2}\right)\left(1 + \frac{E_3}{2}\right)\left(1 + \frac{E_6}{2}\right)\left(1 - \frac{E_4}{2}\right)\left(1 - \frac{E_5}{2}\right)$$

$$= A\sqrt{\frac{BC}{DG}}\left(1 + E_1 + \frac{E_2}{2} + \frac{E_3}{2} + \frac{E_6}{2} - \frac{E_4}{2} - \frac{E_5}{2}\right)$$

and the maximum per cent error in:

$$Qh_{cal.} = \pm\left(E_1 + \frac{E_2}{2} + \frac{E_3}{2} + \frac{E_4}{2} + \frac{E_5}{2} + \frac{E_6}{2}\right)$$

Therefore, if we state that B, C, and D are initially measured and recorded to within 0.5 per cent, the empirical equation for A is within 2 per cent and the planimeter machine error (plus the repeatability factor of the human operator in curve tracing) is 1 per cent, G is initially measured and recorded to within 1 per cent, the maximum error in Qh calculated would be 3.750 per cent. Since, statistically, all errors will not have the same sign, we may safely state that the probable error is 1.875 per cent. This probable error is very close to the maximum error of 2 per cent which is permitted in calculating gas flow in most contracts.



• Specific gravity analysis

Specific gravity of natural gas from one source (Southwest in the Columbia Gas System) ranged from .578 to .590, a variation of ±1 per cent. Manufactured gas ranged from .575 to 1.000 from plant to plant; however, from any single plant, the variation is closer to the 1 per cent figure. Errors in measuring and recording specific gravity seem to be as high as the variation itself. In the Anubis and Acme gravitometer, calibration is maintained to ±.005 of the reading. At .600 s.g., this is almost ±1 per cent. Repeatability in the present planimeter operation is considered to be ±.5 per cent, with a±.5 per cent machine error in the planimeter itself. The effect that these errors have in the calculated gas flow quantity are shown as E_5 and E_6 in the previous error equation.

Considering all other inputs to be perfect, the specific gravity determination, recording, and area integration causes a maximum error of 1 per cent in the gas flow rate. As shown below, when specific gravity changes are differentiated with respect to Qh, this 1 per cent maximum error is twice as large as would be introduced by considering average s. g. as part of the basic constant. If the average specific gravity were to vary more than a predetermined amount, as may be experienced if the dispatcher were to switch to a different gas supply, this basic constant may be changed by making a manual correction to the computer. Since the lineal velocity of gas ranges from 9 to 27 mph, in most installations, almost four hours would elapse before this change in gas was felt at a metering station 100 miles from the source in the greatest velocity system. Such a time lapse appears to be more than sufficient for making manual corrections to a computer constant.

For computer mechanization, equation (7) requires four variable inputs plus a constant K which must permit changing when an orifice is replaced or when gas supply changes. Since specific gravity, in most installations, will be varying over a rather small range, equation (7) may be changed to show the variation in Qh with respect to △G.

At any given instant, except for △G, the extension

$$K\sqrt{\frac{h_w P_f}{T_f G}} = \frac{A}{\sqrt{G}} \text{ with A a constant} \qquad (8)$$

and,

$$Qh = \frac{A}{\sqrt{G}} \qquad (9)$$

Differentiating Qh with respect to G:

$$Qh = A\,G^{-1/2}$$

$$\frac{d\,Qh}{d\,G} = -\frac{A}{2}\,G^{-3/2}$$

$$= -\frac{A}{2G\sqrt{G}}$$

Substituting Qh for $A/\sqrt{G}$:

$$\frac{d\,Qh}{d\,G} = -\frac{Qh}{2G}$$

Therefore,

$$\frac{d\,Qh}{Qh} = -\frac{1}{2}\frac{d\,G}{G} \qquad (10)$$

Equation (10) is in a form which represents a relative change in Qh with respect to a relative change in G with the minus sign showing that Qh increases with a decrease in the value of G. Change in Qh with respect to T_f would follow the same form. However, since T_f does not change more than G, in per cent, it should not be considered as anything but an independent variable.

From equation (10) we see that the relative change (or error) in Qh is one-half that of the relative change (or error) in G. Since G changes, in most installations less than 2 per cent, if the average value of G were used as part of the constant K in equation (7), the change in Qh with a change in G would only amount to ±0.5 per cent. This change (or error) is well within the 2 per cent accuracy that Qh is computed to. Therefore, using an average value of G, for those installations where G varies 2 per cent or less, as part of the constant K, without necessitating a separate computer input for G, is justified. Also, it is apparent that by neglecting G as a variable computer input and incorporating it in the value of K, the resultant error in Qh is less than it would be if the computation error for considering a varying G were introduced into the system. Hence, equation (7) reduces to:

$$Qh^2 = K_1 \frac{h_w P_f}{T_f} \qquad (11)$$

where:

$$K_1 = (K)^2 \frac{1}{\frac{G_{min.} + G_{max.}}{2}} \text{ with } \frac{\Delta G}{G} \times 100 \leq 2\% \qquad (12)$$

and for computer mechanization, the square root is extracted as a final step to obtain a voltage proportional to Qh.

GAS FLOW COMPUTER

The computer system used to solve equation (11) is composed of solid-state analog elements using electronic time division multipliers. The theory of the Link Electronic Time Division Multiplier (ETDM) has been described in other reports[3]. Basically, the ETDM is a feedback multiplier whereby multiplication is achieved by simultaneous pulse width and pulse amplitude modulation of an internally generated square wave. The integrated output of this pulse width and pulse amplitude modulated square wave is the product of two independent variables. *Fig. 1* shows the three printed circuit cards, and time division system, which comprise one ETDM unit.

Fig. 2 shows the basic gas flow computer in a single run metering station employing local measurement. In this system, pressure and temperature transducers convert h_w, P_f, and T_f into an analog voltage which is fed directly into the computer. The basic orifice constant (K), which includes the supercompressibility and specific gravity, is manually set in this computer, the square root is extracted, and the output is a voltage proportional to rate of gas flow at standard conditions in cubic feet per hour. This output provides the drive for any standard integrating recorder. It may also be used to operate a controller which may be employed to regulate the gas flow or to bring additional runs into service automatically when the rate exceeds a preset limit.

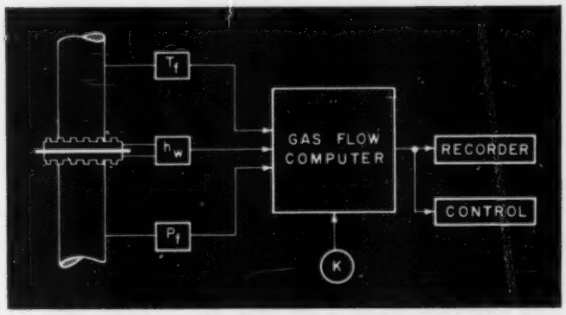


Fig. 2. Single metering station gas flow computer system.

• Electronic time division system

In the ETDM, the system equation states:

$$V_o = -V\frac{t_1 - t_2}{T} = +\frac{XY}{V_R} \qquad (13)$$

where X and Y are independent input variables and V_R is a 10-v d-c reference voltage applied to a transistor switch so that the inherent scaling of the system will result in a maximum output voltage of 10 v d-c when the two inputs are both 10 v d-c.

Since in equation (11), it is desired to divide by T_f, the voltage reference may be substituted by T_f if temperature variation remains in a ratio such that:

$$\frac{T_{f_1}}{T_{f_2}} < 2$$

In all gas metering stations, the flowing gas temperature will remain within this limit since T_f is expressed in °F absolute, and in many installations the ratio is even smaller since the gas is preheated prior to measurement.

A simple block diagram of the computer mechanization of equation (11) is shown in *Fig. 3*. Square root extraction is performed by replacing the reference voltage with a feedback from the voltage output and using a constant voltage source of 10 v d-c in place of the second variable. This results in multiplying the first variable by unity.

$$V_o = \frac{XY}{V_R} \qquad (14)$$

replacing V_R with a feedback from the output and replacing Y with a constant 10-v source:

$$V_o = \frac{X\,(1)}{V_o} \qquad (15)$$

$$(V_o)^2 = X$$
$$V_o = \sqrt{X}$$

which is the desired result, since X in the system is $(Qh)^2$ from the first multiplier section.

• Error analysis

Assuming perfect inputs for h_w, P_f, and T_f, the theoretical error of an ETDM system can be analyzed using *Fig. 4*.

For maximum error, the individual errors are E_1 = .2 per cent, E_2 = 1 per cent, E_3 = .1 per cent, E_4 = .2 per cent and assuming perfect inputs with perfect sign inversion amplifiers, when necessary:

$$V_5 = (V_o)^2 (1 + E_1) \left[1 + \frac{P_R}{P_R + R_R} E_2 + \frac{R_R}{R_R + P_R} E_3\right]$$

when the ratio of P_R/R_R = .5 and R_R = 100K:

$$V_5 = (V_o)^2 (1 + E_1) (1 + .33\ E_2 + .66\ E_3)$$
$$V_5 = (V_o)^2 (1 + E_1 + .33\ E_2 + .66\ E_3)$$
$$V_o (1 + E_5) = \sqrt{(V_o)^2 (1 + E_1 + .33\ E_2 + .66\ E_3)}\ (1 + E_4)$$
$$V_o (1 + E_5) = V_o \left(1 + \frac{E_1}{2} + \frac{.33\ E_2}{2} + \frac{.66\ E_3}{2}\right) (1 + E_4)$$

neglecting E of higher than first order of magnitude:

$$E_5 = \frac{E_1}{2} + \frac{.33\ E_2}{2} + \frac{.66\ E_3}{2} + E_4$$

substituting error values:

$$E_5 \text{ max.} = \frac{.2}{2} + \frac{.33}{2} + \frac{.06}{2} + .2$$
$$E_5 \text{ max.} = .5\%$$

As shown in *Fig. 4*, for error analysis purposes, the two multipliers have unity gain and the output of the first section is attenuated by the voltage divider R and P for insertion of the constant K. These calculations do not consider any loading effect of the potentiometer caused by lack of infinite input impedance of the amplifier. However, in the actual system, shown in *Fig. 5*, this voltage divider was inserted as part of the feedback loop of the h_w amplifier so that gain of this stage is varied as a function of K, thus avoiding any loading effect. Consequently, the error analysis, as shown, remains valid since the potentiometer error is the same in both cases as long as the ratio of P to R in the feedback loop is .5.

• Computer dynamic range

A survey of typical gas metering installations[4] shows that in most primary orifice distributing stations throughout the country there may be 1 to 4 orifice runs with pipe sizes varying from 4 to 8 in. and orifice diameters of 1 to 6 in. A few companies serving large metropolitan areas may have larger than 8-in. pipes but usually the cost of installing these larger systems versus the loss in flexibility of, say, two 10-in. runs, reduces their occurrences.

Although the computer system shown in *Fig. 5* may be scaled for any dynamic range, it is advantageous to scale analog systems so that the average output is near full output of the system in order to keep the

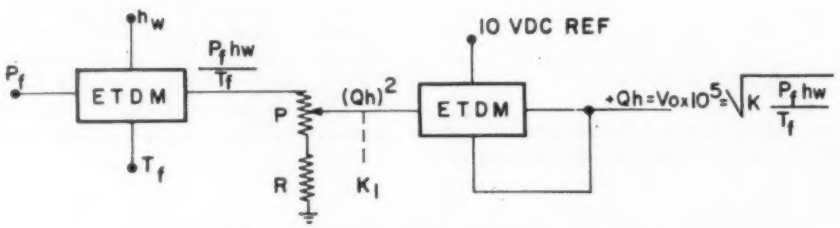


Fig. 3. Basic automatic gas flow computer.

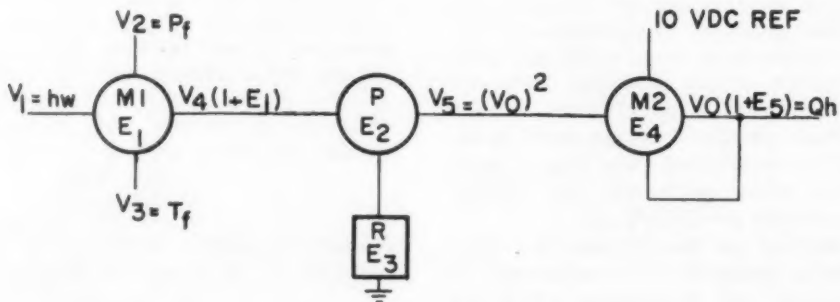


Fig. 4. Computer error analysis diagram.

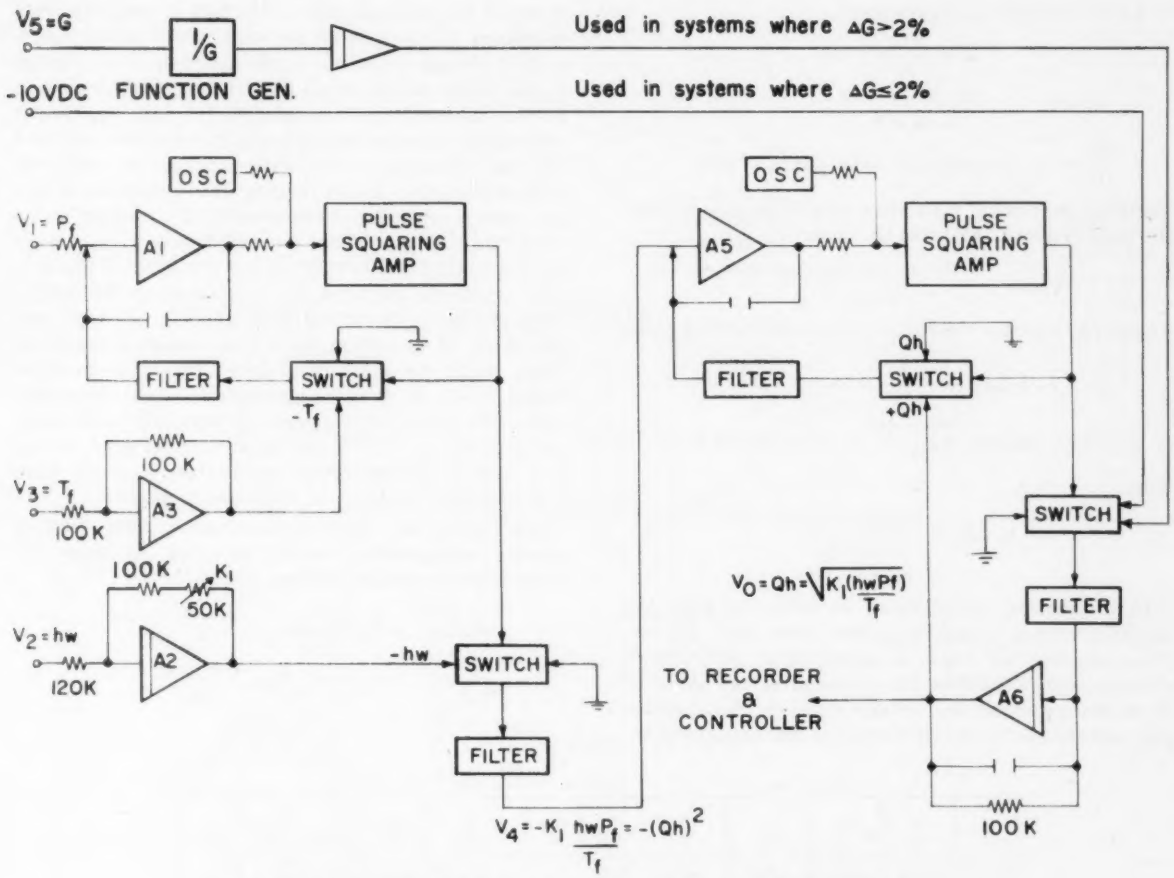


Fig. 5. Automatic gas flow computer schematic, one quadrant operation.

percentage error to a minimum. Consequently, the system shown, and instrumented in the laboratory, has been limited to the following ranges of parameters. This limitation, however, gives a dynamic range which exceeds the bandwidth of most installations.

Fig. 5 shows the electronic switch of the second multiplier unit with alternative inputs. The 10 v d-c reference voltage is used in those installations where specific gravity varies less than 2 per cent, and is included, as previously described, in the constant K. The alternative input, V_5, is only used where specific gravity changes more than 2 per cent. In these cases, the function 1/G appears as a multiplier of the extension $P_f h_w/T_f$, together with the constant K, whose determination does not include specific gravity.

Scaling

P_f – Range 25-100 psia (ratio 1:4 – could be 1000-4000 psia)

h_w – Range 5-100 inches of water (ratio 1:20 – could be 10-200)

T_f – Range −20° F to +90° F = 440° F absolute – 550° F absolute

C′ – Range 238 to 8943

P_f max. = 100 = 8 volts d-c

P_f min. = 25 = 2 volts d-c

h_w max. = 100 = 10 volts d-c

h_w min. = 5 = .5 volts d-c

T_f max. = 550 = 10 volts d-c

T_f min. = 440 = 8 volts d-c

$$K_{max.} = \frac{C' \text{ max.}}{\sqrt{1/T_f \text{ max.}}} = \frac{8943}{\sqrt{1/550}} \cong 209{,}800 = 20.98 \times 10^4$$

$$K_1 \text{ max.} = (K_{max.})^2 = 44 \times 10^9 = 440 \times 10^8$$

$$K_{min.} = \frac{C' \text{ min.}}{\sqrt{1/T_f \text{ min.}}} = \frac{238}{\sqrt{1/440}} = 5 \times 10^3$$

$$K_1 \text{ min.} = (K_{min.})^2 = 25 \times 10^6$$

To set the output of the first multiplier to 10 volts where R_1 = feedback resistor, R_i = input resistor, and R_f/R_i = a:

$$V_4 \text{ max.} = 10 \text{ volts} = \frac{\left(V_1 \frac{R_f}{R_i}\right)\left(V_2 \frac{R_f}{R_i}\right)}{V_3 \frac{R_f}{R_i}}$$

$$V_4 \text{ max.} = 10 \text{ volts} = \frac{(P_f \text{ max.})\,(a_1)\,(h_w \text{ max.})\,(a_2)}{(T_f \text{ min.})\,(a_3)}$$

where for summer operation in a typical installation, P_f max. = 100 psia = 100/125 × 10 v d-c = 8 v d-c.

$$10 = \frac{(8\ a_1)\ (10\ a_2)}{8\ a_3}$$

Setting for convenience, all gains equal:

$$10 = \frac{80\ a^2}{8a} = 10a$$

$$a = 1$$

$$\frac{R_f}{R_i} = 1 \text{ and make } R_f = 100 \text{ K and } R_i = 100\text{K}$$

Checking minimum multiplier output to insure that the level is above any noise or ripple:

$$V_4 \text{ min.} = \frac{(P_f \text{ min.})\ (1)\ (h_w \text{ min.})\ (1)}{(T_f \text{ max.})\ (1)}$$

where for summer operation, in typical installation:

$$P_f = 50 \text{ psia} = \frac{50}{125} \times 10 = 4 \text{ v d-c}$$

$$T_f = 50^\circ \text{ F} = \frac{460 + 50}{550} \times 10 = 9.3 \text{ v d-c}$$

then,

$$V_4 \text{ min.} = \frac{(4)\ (1)\ (.5)\ (1)}{(9.3)\ (1)}$$

$$= .215 \text{ v d-c}$$

In a practical installation, in order to keep the amplifier output voltage at a level more than 200 mv. above any residual noise, to reduce error percentages, a range switch could be incorporated at the input of V_1 to change either the voltage input or the amplifier gain. Although this would require a manual operation, it would be practical due to the fact if pressure were to change as much as 60 per cent of the scaled range, such a change would no doubt also require a change in the orifice which would require a manual correction to the value of the constant K_1. If fully automatic operation, in an installation which does have pressure varying throughout the entire range, is required, voltage-sensitive relays across the amplifier output can be incorporated to automatically change gains when the voltage reaches a predetermined lower level. Such a system would also change the gain of the output, or record amplifier, in order to keep the output voltage scaling factor the same in both the high and low mode of operation. In a relay sensing operation there would be a 5-15 ms. switching time duration which would result in a meaningless output. However, since this period of transient is infinitely small compared to the rate of change in parameters encountered in a typical gas metering installation, it would have a negligible influence on the overall output.

Also, since K_1 varies approximately 2000 to 1, a similar arrangement would be used to keep the potentiometer within scaling limits.

$$V_4 \text{ max.} = 10 \text{ volts d-c} = \frac{h_w \text{ max. } P_f \text{ max.}}{T_f \text{ min.}}$$

$$= \frac{(100)\ (100)}{440}$$

$$= 22.7$$

P_f psia	V_1 VDC	h_w in. of water	V_2 VDC	T_f °F	V_3 VDC	POT N.	K_1 $(K)^2$	Q_h, ft^3, $Vo(10^5)\ h_r$	V_O VDC	DEV (MV)	% Error
100.1	8.010	33.04	3.304	-20.00	8.000	8	41.08 x 10^9	162,680	1.626	-1	.062
100.0	8.001	98.01	9.801	35.00	9.000	10	44 x 10^9	852,109	8.516	-5	.057
97.50	7.800	96.01	9.601	35.00	9.000	10	44 x 10^9	832,709	8.324	-3	.036
95.00	7.600	94.00	9.400	35.00	9.000	10	44 x 10^9	813,314	8.130	-3	.037
92.50	7.400	92.00	9.200	35.00	9.000	10	44 x 10^9	793,958	7.940	+1	.013
90.00	7.200	90.00	9.000	35.00	9.000	10	44 x 10^9	774,596	7.746	+1	.013
87.50	7.000	88.02	8.802	-20.00	8.001	10	44 x 10^9	801,081	8.010	0	0
85.01	6.801	86.00	8.600	-20.00	8.001	10	44 x 10^9	780,499	7.800	-4	.051
82.50	6.600	84.01	8.401	-20.00	8.001	10	44 x 10^9	759,931	7.602	+3	.039
80.03	6.402	82.01	8.201	-20.00	8.001	10	44 x 10^9	739,483	7.393	-1	.014
77.54	6.203	80.00	8.000	-19.99	8.002	10	44 x 10^9	718,879	7.189	+1	.014
75.01	6.001	78.01	7.801	-19.99	8.002	10	44 x 10^9	698,227	6.983	+1	.014
100.00	8.001	98.02	9.802	89.07	9.983	5	36.68 x 10^9	767,590	7.663	-12	.156
97.51	7.801	96.02	9.602	89.07	9.983	5	36.68 x 10^9	750,163	7.491	-10	.133
95.01	7.601	94.02	9.402	89.07	9.983	5	36.68 x 10^9	732,732	7.319	-8	.109
92.51	7.401	92.01	9.201	89.07	9.983	5	36.68 x 10^9	715,258	7.144	-8	.112
90.01	7.201	90.01	9.001	89.07	9.983	5	36.68 x 10^9	697,817	6.970	-8	.115
87.50	7.000	88.01	8.801	89.07	9.983	5	36.68 x 10^9	680,322	6.795	-8	.118
85.00	6.800	86.01	8.601	11.75	8.500	5	36.68 x 10^9	718,373	7.173	-10	.139
82.50	6.600	84.00	8.400	11.75	8.500	5	36.68 x 10^9	699,411	6.989	-5	.071
80.01	6.401	82.00	8.200	11.75	8.500	5	36.68 x 10^9	680,537	6.797	-8	.118
77.51	6.201	80.01	8.001	11.75	8.500	5	36.68 x 10^9	661,643	6.607	-9	.136
75.01	6.001	78.01	7.801	11.75	8.500	5	36.68 x 10^9	642,699	6.420	-6	.093
71.61	5.729	87.30	8.730	88.90	9.980	10	44 x 10^9	646,235	6.465	+3	.046
71.61	5.729	87.30	8.730	88.90	9.980	9	42.54 x 10^9	639,740	6.401	+4	.063
71.61	5.729	87.29	8.729	88.84	9.979	8	41.08 x 10^9	633,174	6.334	+3	.047
71.61	5.729	87.29	8.729	88.84	9.979	7	39.61 x 10^9	626,543	6.269	+4	.064
71.61	5.729	87.29	8.729	88.84	9.979	6	38.14 x 10^9	619,842	6.203	+5	.081
71.61	5.729	87.29	8.729	88.84	9.979	5	36.68 x 10^9	613,068	6.138	+8	.131
71.61	5.729	87.29	8.729	88.90	9.980	4	35.21 x 10^9	606,187	6.067	+6	.099
71.61	5.729	87.29	8.729	88.90	9.980	3	33.74 x 10^9	599,259	5.999	+7	.117
71.61	5.729	87.29	8.729	89.01	9.982	2	32.27 x 10^9	592,191	5.934	+13	.220
71.61	5.729	87.29	8.729	88.96	9.981	1	30.81 x 10^9	585,127	5.859	+8	.137
71.61	5.729	87.29	8.729	88.96	9.981	0	29.33 x 10^9	577,948	5.787	+8	.138
26.24	2.099	47.79	4.779	88.96	9.981	10	44 x 10^9	289,399	2.898	+5	.173
26.24	2.099	47.79	4.779	88.96	9.981	9	42.54 x 10^9	286,490	2.870	+6	.209
26.24	2.099	47.79	4.779	88.90	9.980	8	41.08 x 10^9	283.566	2.840	+5	.176
26.24	2.099	47.79	4.779	88.90	9.980	7	39.61 x 10^9	280,596	2.813	+8	.285
26.24	2.099	47.79	4.779	88.90	9.980	6	38.14 x 10^9	277,595	2.783	+8	.288
26.24	2.099	47.79	4.779	88.90	9.980	5	36.68 x 10^9	274,561	2.748	+3	.109
26.24	2.099	47.79	4.779	88.90	9.980	4	35.21 x 10^9	271,493	2.721	+7	.258
26.24	2.099	47.79	4.779	88.90	9.980	3	33.74 x 10^9	268,391	2.691	+8	.298
26.24	2.099	47.79	4.779	88.90	9.980	2	32.27 x 10^9	265,251	2.661	+9	.339
26.24	2.099	47.79	4.779	88.90	9.980	1	30.81 x 10^9	262,075	2.629	+9	.344
26.24	2.099	47.79	4.779	88.90	9.980	0	29.33 x 10^9	258,859	2.597	+9	.348

Fig. 6. Dynamic operation table.

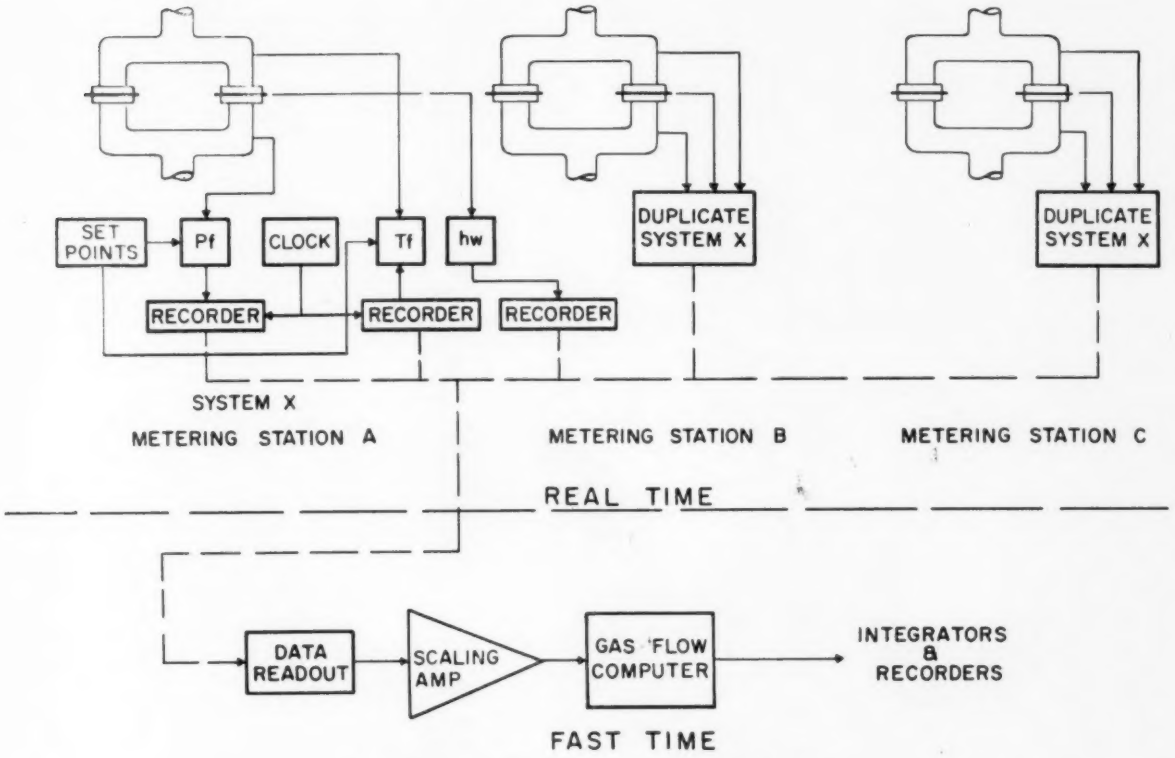


Fig. 7. Multiple meter stations, gas flow computer system.

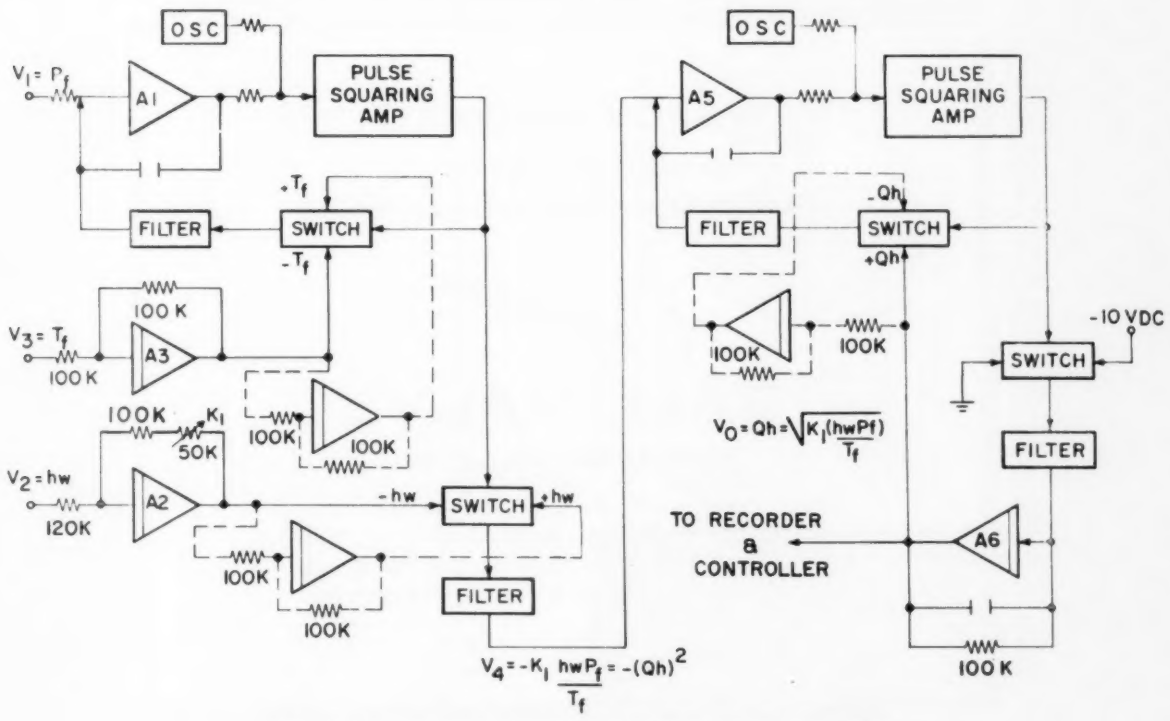
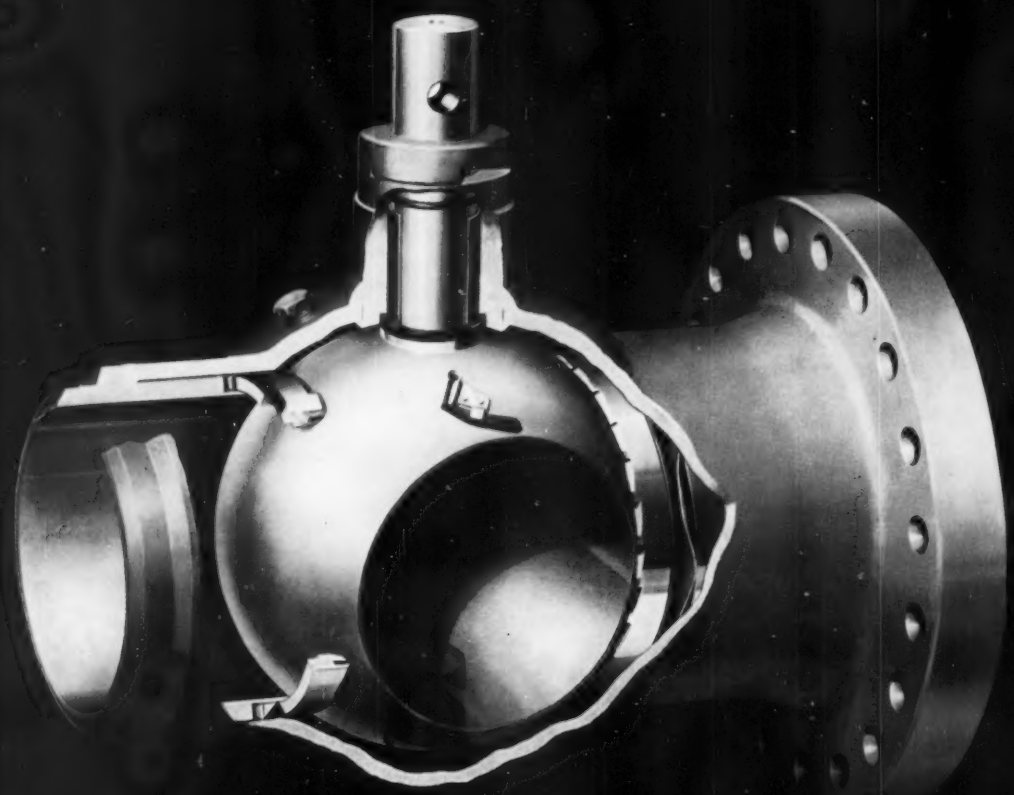


Fig. 8. Automatic gas flow computer schematic, four quadrant operation.



NEW—FOR GENERAL USE

For Pipe Lines—Chemical, Refining and Gas Processing Plants—Oil Well Drilling and Producing

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BALL VALVE

with the Exclusive Rotating Seats

These valves handle the most abrasive and corrosive fluids—cannot freeze—cannot develop excessive body pressure; provide up-stream seating, double block and bleed, all with unbelievably easy operation.

CAMERON BALL VALVES SEAL ON A NEW SURFACE WITH EACH OPERATION

ROTATING SEAT PRINCIPLE

CAMERON BALL VALVES use an advanced form of the exclusive rotating seat principle* made famous in Cameron's Type "F" Gate Valve. Each operation of the valve partially rotates the seat to change the relation of the mating surfaces and to provide a continuous reseating action.

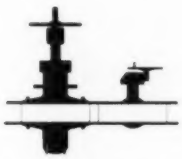
The astounding improvement in service life and tightness brought on by this advancement places the CAMERON BALL VALVE in a completely new dimension of reliability and extended use—permits for the first time "sealed for life" construction.

*Patents Applied For

NEW MANUFACTURING CONCEPT

Cameron has developed a new technique of manufacture, incorporating a new design*, which permits forging, machining and welding in successive steps. This results in a new kind of structure that is totally accurate and the ultimate in simplicity.

*Patents Applied For

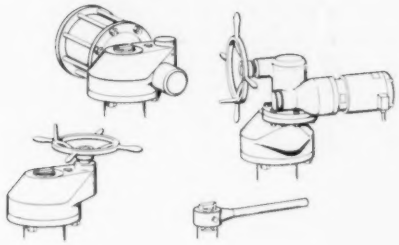


COMPACT DESIGN

This new design concept eliminates bonnets, gaskets and joints and all the problems that arise from them. The weight of these valves is remarkably low and they require only a fraction of the space needed for other valves.

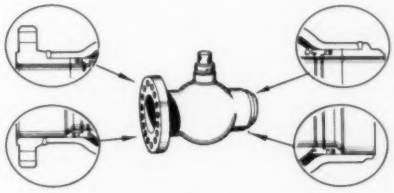
NO MORE LUBRICATION

CAMERON BALL VALVES require no lubrication at any time. Moving surfaces slide on low friction Teflon to seal all joints and provide a life-time of easy operation and bubble-tight service without lubrication.



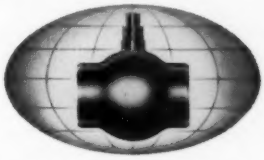
OPERATORS

The CAMERON BALL VALVE requires only a fraction of the effort that other valves must have to operate. Much larger valves may be lever operated with ease. When necessary, highly efficient gear operators requiring a minimum of turns and effort are provided. All types of electrical, pneumatic and hydraulic operators manufactured by Cameron are available and special operation problems are solicited. Operators of other manufacture may be installed on request.



SIZES AND TYPES

CAMERON BALL VALVES are available in regular and full bore sizes from 2" to 36" in W.P. 150 psi to 5000 psi. They may be provided, with any end preparation required. Larger bore sizes are available on special order.



CAMERON BALL VALVES are available and will be manufactured worldwide in five Cameron Plants—France, England, Canada, Mexico and the United States. Processes in each plant follow the same specifications and rigid controls established by the home plant in Houston, Texas.

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IRON WORKS, INC.
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Export Office: 7912 Empire State Bldg., New York City, In England
Cameron Iron Works Ltd., 76 Grosvenor St., London W. 1, England

$$V_5 \text{ max.} = (Qh)^2 \text{ max.} = (V_4 \text{ max.})\ (K_1 \text{ max.})$$
$$= (22.7)\ (44 \times 10^9)$$
$$= 10^{12} = 10 \text{ volts d-c}$$

$$V_o \text{ max.} = \sqrt{V_5 \text{ max. } (10)},$$

where the multiplier (10) is a scaling factor in the ETDM and,

$$V_o \text{ max.} = 10 \text{ volts d-c}$$

which is the analog for

$$Qh \text{ max.} = 10^6$$

therefore,

$$Qh = V_o \times 10^5$$

• Program example

For a typical example, to show programming sequence of the computer, assume the following installation:

D = line size = 8.071 actual inside diameter
d = orifice size = 5.000 in.
T_f = 50° F = 510° absolute
P_b = 14.73
T_b = 60° F
G = .595 av.
H = 999.1 Btu per cu ft
h_w = average differential head − 80 in. water
P_f = 75 psig

Average downstream absolute static pressure = average barometric pressure + P_f = 14.4 + 75 = 89.4 psia

From equation (12):

$$C' = (F_b)\ (F_r)\ (Y)\ (F_{pb})\ (F_{pv})\ (F_m) \sqrt{1/G_{av}} \sqrt{1/T}$$
$$= 8413.04 \text{ (from table entry)}$$

and

$$C' = \sqrt{K\ 1/T_f}$$

$$K = \frac{C'}{\sqrt{1/T_f}} = \frac{8413.04}{\sqrt{1/510}} = (22.584)\ (8413.04) = 19 \times 10^4$$

This method for determining C′ may vary from one installation to another. However, the method used to determine K (a constant) in the above equation uses an independent variable T_f in the radical. Since C′ also contains the same T_f, they cancel leaving K as a constant.

$$K_1 = (K)^2 = 36.1 \times 10^9$$

$$V_1 = P_f = \frac{89.4}{100} \times 8 = 7.152 \text{ volts d-c}$$

$$V_2 = h_w = \frac{80}{100} \times 10 = 8.000 \text{ volts d-c}$$

$$V_3 = T_f = \frac{510}{550} \times 10 = 9.273 \text{ volts d-c}$$

$$K_1 = 36.1 \times 10^9 = \text{N turns}$$

To solve for N in a 10-turn potentiometer with 5000 ohms/turn;

$$\frac{K_1}{K_1 \text{ max.}} = \frac{100{,}000 + 5000\ N}{150{,}000}$$

$$N = \frac{(150{,}000)\ (36.1 \times 10^9) - (44 \times 10^9)\ (100{,}000)}{(44 \times 10^9)\ (5000)}$$

N = 4.614 turns for value of $K_1 = 36.1 \times 10^9$

$$V_4 = \frac{P_f\ h_w}{T_f}\ \frac{2}{3} + \frac{4.614}{30} = 5.0623 \text{ volts d-c}$$

$$V_o = \sqrt{V_4\ (10)} = \sqrt{50.623} = 7.1149 \text{ volts d-c}$$
$$Qh = 7.1149 \times 10^5 = 711{,}490 \text{ cu. ft./hr.}$$

Also

$$Qh = C' \sqrt{h_w\ P_f}$$

$$Qh = 8413.04 \sqrt{80 \times 89.4} = 711{,}491 \text{ cu. ft./hr.}$$

• Dynamic operation

Instrumentation results of the dynamic operation of the gas flow computer over a wide range of inputs is shown in *Fig. 6*. A maximum per cent error of less than .4 per cent was achieved over the entire output range. No special precautions were taken to achieve these results. The operational amplifiers were zeroed once when the computer was set up, and no further adjustments were made. The 10-turn potentiometer was calibrated to give 5/6 of maximum output of the hh_w amplifier at the 5-turn position. The inputs h_w, P_f, and T_f were set into the computer within the measurement accuracies of a digital voltmeter, and V_o was recorded from the same voltmeter. These tests were re-run with a resultant repeatability over the entire range within ±3 mv.

• Fast time operation

The systems discussed so far are for real time computation where local measurements form direct inputs to the computer. In those gas service systems that have as many as four runs in each metering station, with as many as four stations in the system, the use of the computer on a fast time basis is probably justified. In this application, the transducer output would be stored on magnetic tape, on a real time basis, then programmed into a central computer on a fast time basis as shown in *Fig. 7*. It would not be necessary to record all the variables continuously. Temperature and static pressure would be recorded only when a change which exceeds a preset limit occurs, along with the time between those changes. The differential pressure would be recorded continuously. Tapes will also provide a permanent record of the variables involved.

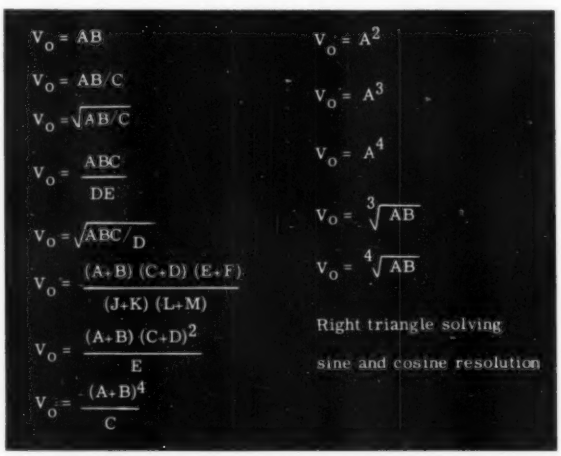
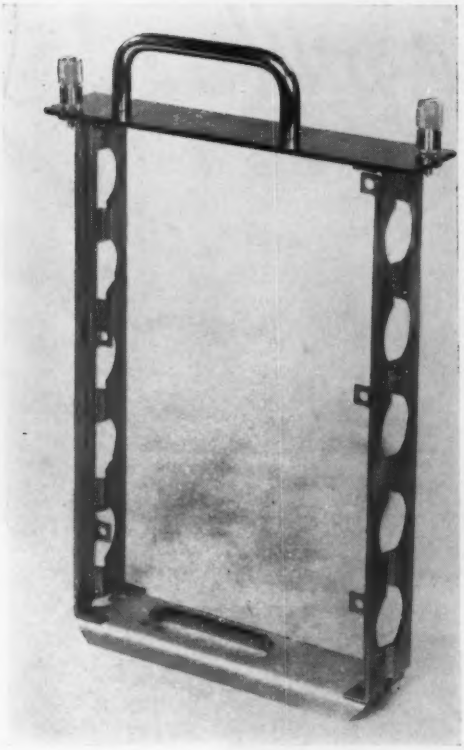


Fig. 9. Computer versatility, showing general form equation examples.



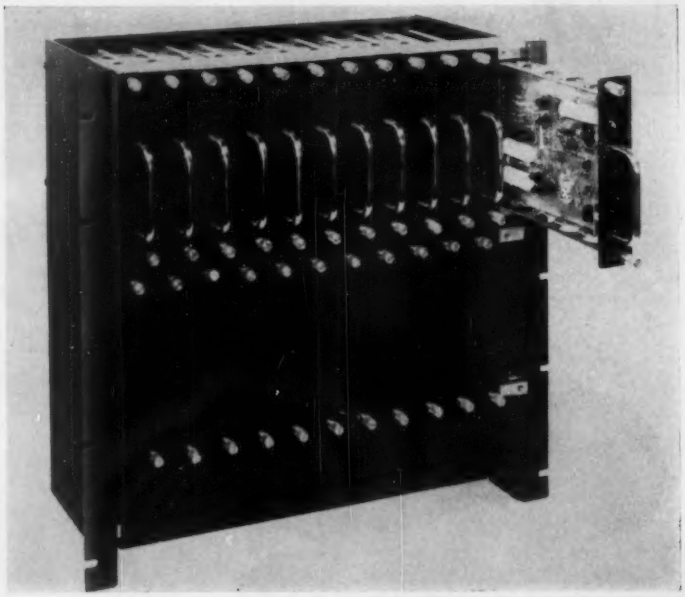


Fig. 10 (left). Printed board frame. Fig. 11 (above). Basic computer section.

In a large natural gas transmission system, where the parameter charts are sent to a central location for integration and subsequent billing procedures, this gas flow computer may be used to relieve many of the manual operations. In this type system, the tape inputs would be substituted by the analog outputs from electronic chart scanners. Such an application would eliminate the need for scheduling computation time on a large digital computer for orifice metering billing purposes. The capital outlay for a special purpose analog computer of this type described would be less than the proportional annual rental for which is currently being charged off for meter billing time on these large computers.

• Computer system versatility

Although the three buffered amplifiers used for sign inversion in *Fig. 8* are not required for the basic gas flow computer, since all parameters are of a positive voltage magnitude, they are included in the system to show further versatility of this mechanization. If a patchboard were included in the system, a two multiplier computer using electronic time division principles can be mechanized to solve the general form equations shown in *Fig. 9*. The list is not conclusive, and many other variations may be solved. Any of these general forms may be multiplied by a constant.

• Packaging

Because packaging requirements for the installation of the gas flow computer may vary between customer, modular techniques were chosen. *Fig. 10* shows a metal frame used to give cards support and protect the components on the board. These frames are guided into positive contact with the associated connectors by the two slide channels shown. One computer section comprises a rack which houses 12 amplifiers in the top shelf with the associated input computation cards in the bottom shelf, as shown in *Fig. 11*. All programming is done in the bottom shelf where the wireways are enclosed. This modular technique permits amplifier removal for checking purposes without necessitating the disturbance of the existing program. In the gas flow computer, the five operational amplifiers of *Fig. 5* are located in the top shelf with the associated summing cards, two conversion cards, and two switch cards located in the bottom shelf. ■

ACKNOWLEDGEMENT

The author wishes to thank Dr. Kurt Jenkner, Link Division, General Precision Inc. for valuable discussions on the material in this article, and particularly for his assistance in the error analysis. The dynamic data presented in *Fig. 6* was obtained by Frank Chapchuk and Bob Traxler of Link Division. Appreciation is also expressed to personnel of the Columbia Gas System for their encouragement toward the material presented in this article.

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[2] AGA, Gas Measurement Committee Report No. 3, Apr. 1, 1955, Equation (1).

[3] "A Transistorized Four-Quadrant Time Division Multiplier with an Accuracy of 0.1 Per Cent," IRE Transactions on Electronic Computers, Vol. EC-7, March 1958.

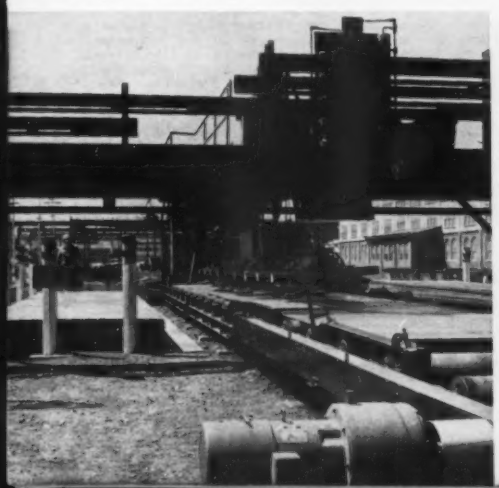
[4] P. H. Papastrat, Division Superintendent, Home Gas Co. of Columbia Gas System, private communication.

This article is adapted from a talk presented at the 1960 IRE convention and is appearing in the 1960 IRE National Convention Record.

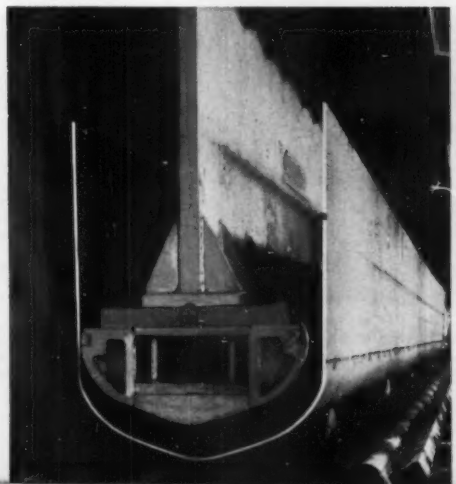
Announcing a new mill...

Steel *for Strength*
. . . Economy
. . . Versatility

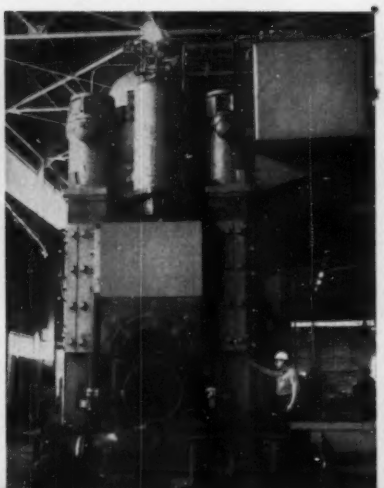
The 40-ft-long plates are handled automatically by this unique one-legged gantry, and delivered to the edge- and end-facing machines.



The prepared plates enter the U-ing press, where they are formed in a matter of seconds. Then . . .



into the mammoth, 18,000-ton-capacity hydraulic O-ing press. This machine can readily form plate ¾ in. thick.



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We're now turning out electric fusion-weld line pipe (18 in. to 42 in. OD) in 40 ft lengths on our new mill at Steelton, Pa. The most modern in the industry, it assures Bethlehem customers of a plentiful supply of pipe meeting API 5LX specifications, as well as non-API pipe in the largest diameters and wall thicknesses presently available anywhere.

The mill's facilities, most of which are equipped with electronic controls, includes newly installed edge and end planers, U-ing and O-ing presses, and welding machines. The only "old" production facilities remaining are the hydraulic pipe expander and the end facer—both installed in 1957.

With this new mill in operation, Bethlehem can meet your most demanding requirements for quality, delivery, and size. The Bethlehem sales office nearest you will give you prompt action on your inquiries.

Line pipe to 16 in. OD made at Sparrows Point, Md.—Our modern electric resistance-weld mill produces API line pipe from 5-9/16 through 16 in. OD, in lengths to 60 ft. We also produce continuous buttweld pipe from 1/2 through 4-1/2 in. OD.

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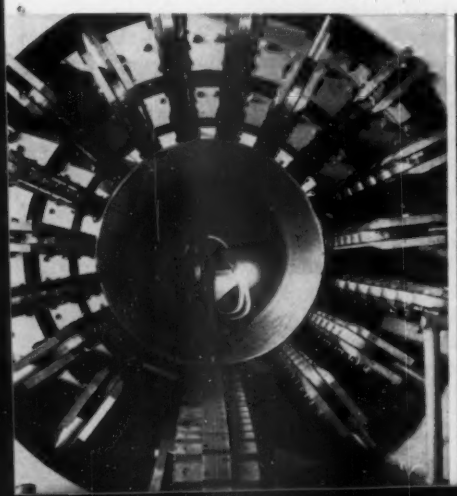
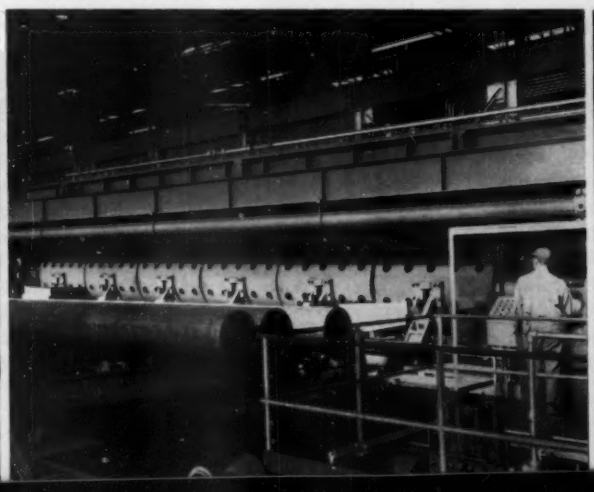
One of the automatic submerged-arc welding machines making an inside seam. Not shown are the outside welders.



After thorough visual inspection the 40-ft lengths are fed into the hydraulic expander. It can expand pipe 42 in. OD, with ¾-in. walls.



After fluoroscopic inspection, the pipe is end-faced as shown here. This operation assures the proper bevel for field-welding.

Natural gas analysis by column chromatography

By RICHARD E. PHILLIPS

Phillips conducted his study as a summer project in the measurement department of Texas Eastern Transmission Corp.'s natural gas division. When the project was completed in August 1959, Phillips was a student in the physics department of MIT.

THIS report is written in conjunction with two summers of employment with Texas Eastern Transmission Corp. The project was conducted under Robert L. Hood at Centenary Testing Laboratories.

A Burrell Kromo-Tog, Model K-2 was used. Column packings were obtained from W. H. Curtin and Burrell. Burrell's Kromo-Tog uses a katharometer, or thermal conductivity cell, for detecting the separated gas mixtures. The apparatus is equipped to vary column length, column packing, column temperature, sample size, effluent, effluent flow rate, and sensitivity of the detector. Installed later was a reverse flow mechanism to flush the column. Helium was used as effluent because of its inert and low adsorptivity characteristics and because it had a thermal conductivity far from that of any sample to be analyzed.

Two criteria were to be satisfied in establishing techniques in chromatographic analysis: speed and accuracy. The speed of an analysis was largely dependent on the type of packing used in the columns. Accuracy depended on the separation the packing gave and the method of calculation of molecular per cent from the chart.

The recorder drew a series of peaks corresponding to methane, ethane, propane, and the heavier constituents of natural gas. The size of the peaks was proportional to the concentration of the sample passing the detector. Both the height and area of these peaks were measured. Neither height nor area are directly proportional to the amount of constituent in the gas stream. But, the area of each peak is also proportional to the thermal conductivity of the gas, the height is proportional to the thermal conductivity and the temperature of the column.

Of course, the total area and height of all the peaks varies with flow rate, detector sensitivity, sample size, and packing, but the size relationship between the peaks remains the same as long as these variables are held constant during the analysis. From physical aspects of the chart it was easier to accurately measure the height of the peaks rather than the area.

Two methods of calculation were tried. In the first method the height of a peak of known composition was compared directly to the height of a peak of unknown percentage for each constituent of the gas. It can readily be seen that the detector sensitivity, flow rate and all the other variables would need to be kept constant during the analysis of known and unknown. Results using this method were only fairly accurate when the known and unknown were analyzed one after the other. It was too difficult to reproduce all the factors which varied between analyses and even during them. Some of the annoying variances can be attributed to the fluctuation of line voltage.

A second method of calculation suggested by D. Carter of Sunray Mid-Continent Oil Co. requires the use of correction factors. The height of each peak of an analysis is multiplied by a correction factor. Then each corrected height is divided by the total height to find the molecular per cent composition of the gas. The correction factors are calculated with a known sample by assuming the correction factor for methane to be one (1.00). The peak height of methane is multiplied by its correction factor to get its corrected area; then if a certain height represents a certain mole per cent in the known, another height represents 100 per cent. This total height is multiplied by the mole per cent of each component of the gas to get the corrected height for each peak. The corrected height was divided by the measured peak heights to find the correction factor. This method requires that the detector sensitivity, column temperature, and flow rate be held constant only during the analysis of the unknown. It has proven very satisfactory.

The versatility of column chromatography is due to the myriad packings that can be used to separate gaseous mixtures. We experimented with six, silica gel, molecular sieves, of the dry type, and tri-isobutylene, 2,4,dimethyl sulfolane, Apiezon L, and a silicone grease all of the coated type. A rapid analysis or elution time and good separation were desired.

Molecular sieves required too long a time to elute propane and the heavier alkanes, but did give separation of nitrogen and oxygen but not carbon dioxide. Silica gel also required too long for propane and heavier but did separate nitrogen and oxygen (under the same peak) and carbon dioxide. By using a heated column and 40 ml/min., flow rate silica gel afforded a practical method of separating nitrogen and carbon dioxide in natural gas.

A direct comparison of peak heights of the unknown to those of a known is the best method of calculation since the analysis is stopped before propane is eluted thus making it impossible to find the total peak height or area. Five milliliters of sample is required. Triisobutylene was so light that it was driven from the column packing by the warm helium. Apiezon L, a heavier grease, gave the best separation of the alkanes but methane, nitrogen, and carbon dioxide are all under the same peak. The analysis is stopped after iso and normal pentane and the flow is reversed to get a peak for hexanes and heavier. Five ml. of sample is required. The analysis time is about 20 minutes. The flow rate is 50 ml. per minute and the column temperature 48 deg C.

Much the same general separation is achieved with 2,4,dimethyl sulfolane except the peaks are broader and not as well separated. With Apiezon L the correction factor method of calculation is best. A very accurate and short, under two hours, analysis of natural gas is achieved by using Apiezon L and silica gel columns. The length of the columns is adjusted to give the shortest elution time and still keep adequate separation of the components.

By making minor changes in the instrument it is possible to increase the detector sensitivity to the point where a one milliliter sample, which is advantageous because it will be better separated, will give large enough peaks to be accurately measured. The increased sensitivity has the drawback of detecting minute variations or "noise" in the output of the rectifiers which provide d.c. current for the detector cell filaments. It may be necessary to use a wet cell battery for filament current supply. A smaller sample can mean the analysis might be speeded up by an increased effluent flow rate or increased column temperature without overlapping one component with another. In addition to speeding up analysis time additional sensitivity will increase the accuracy in the determination of low concentration components.

• An introduction to column chromatography

Paper chromatography was first used to separate pigments in solution. Different pigments had different affinities for the paper and they separated from each other when diffusing through the paper. Many materials could be separated in this way and then identified by dying or chemical testing. This has long been a method of identifying solids in solution.

Recently the characteristic of molecules to adhere to some solids has been put to further use. By packing a small column, one or two meters in length by two or three mils in diameter, with a material having a high adsorptivity it is possible to separate from mixtures gases or liquids in the gas state. Basically this is what the Burrell Kromo-Tog does. In addition, the machine records on a graph the quantity of the various constituents. By comparing the peak heights or peak areas of a known with those of an unknown it is possible to analyze the unknown.

One to five ml. of the sample are trapped in the sampler tube at atmospheric pressure. The effluent then flushes the sample through the column. The effluent must be a lightly adsorbed gas and must have as different a thermal conductivity as possible from the components of the sample. Helium, hydrogen, or nitrogen may be used depending on the packing material and the gases to be separated. Helium is used for fuel gas analysis. Another method of removing the sample gas from the column is by displacing it with a more highly adsorbed gas. Two types of packings are used in the columns: the dry type, using activated charcoal, silica gel, or Florisil, and the liquid partition type using Celite or crushed firebrick as a support for any of a great number of liquid organic adsorbents. The time for an analysis depends of the effluent flow rate, the retention time of the sample, the column temperature, and the adsorbent.

Measuring the separated components is accomplished by four thermal resistant filaments. Two are located in the effluent flow upstream from the sampler, and two are located at the end of the column where the separated sample flows over them. The current through the filaments determines their temperature and thus their sensitivity to changes in the thermal conductivity of the gaseous mixture. The mixture of effluent and gas sample has a different thermal conductivity from the pure gas. The thermal conductivity affects the temperature and thus the resistance of the filaments. This resistance is constantly compared through a Wheatstone bridge; any difference in resistances is amplified and recorded on the graph.

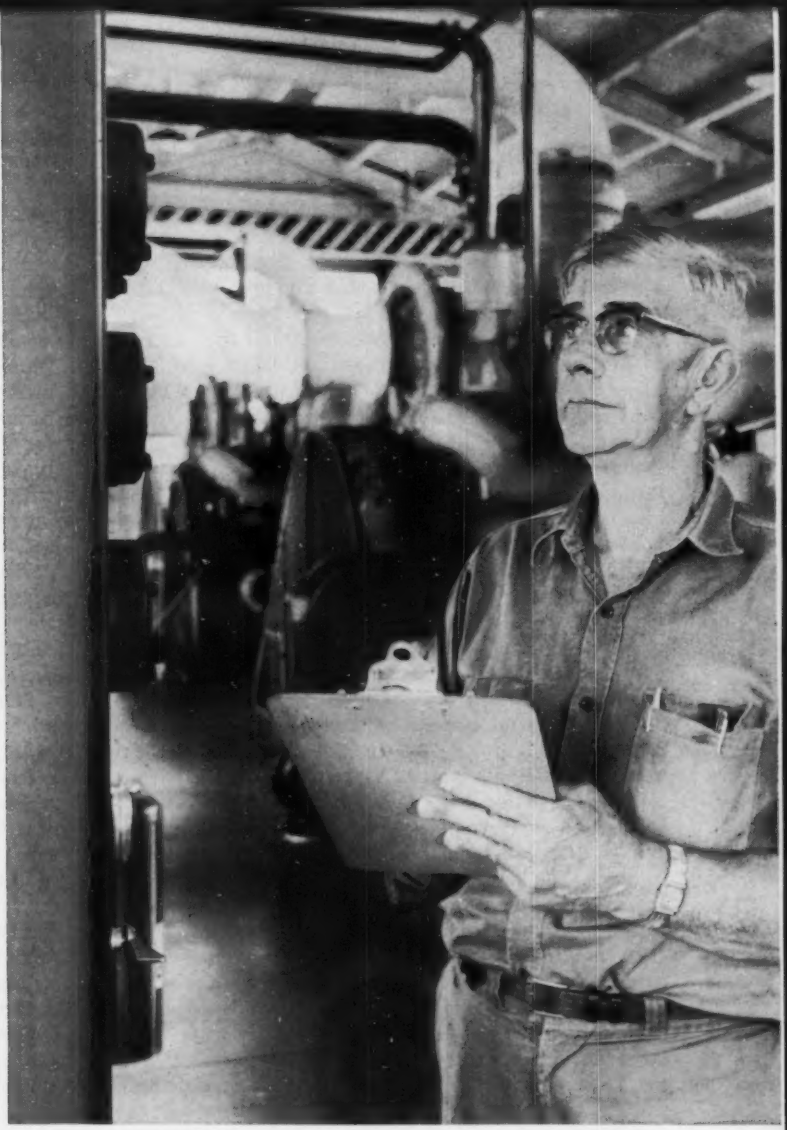
Provided the variables are held constant and only the gas sample is changed, different constituents may be identified by their position on the graph or from the time the test is started as the graph has a time axis. A larger amount of gas will make higher peaks. Too large a sample will result in incomplete separation, while too small a sample will be inaccurate. Too fast a flow rate will result in incomplete separation and will tend to squeeze the peaks together and make them hard to measure. Too slow a flow rate is simply reduced efficiency.

• Continuous run chromatography

With the advent of chromatography as a practical method of separating gases for analysis, it is only natural that an attempt be made to modify and enlarge gas chromatography to include separation of gases in quantity. When and if this technique is developed it will no doubt experience the rapid growth which has characterized column chromatography in analysis work.

A method of separating gases in quantity was discussed at a "vapor phase" chromatography conference in London in 1956: The packing material in chromatography may be thought of as the stationary phase. It separates the constituents of a gas by retaining

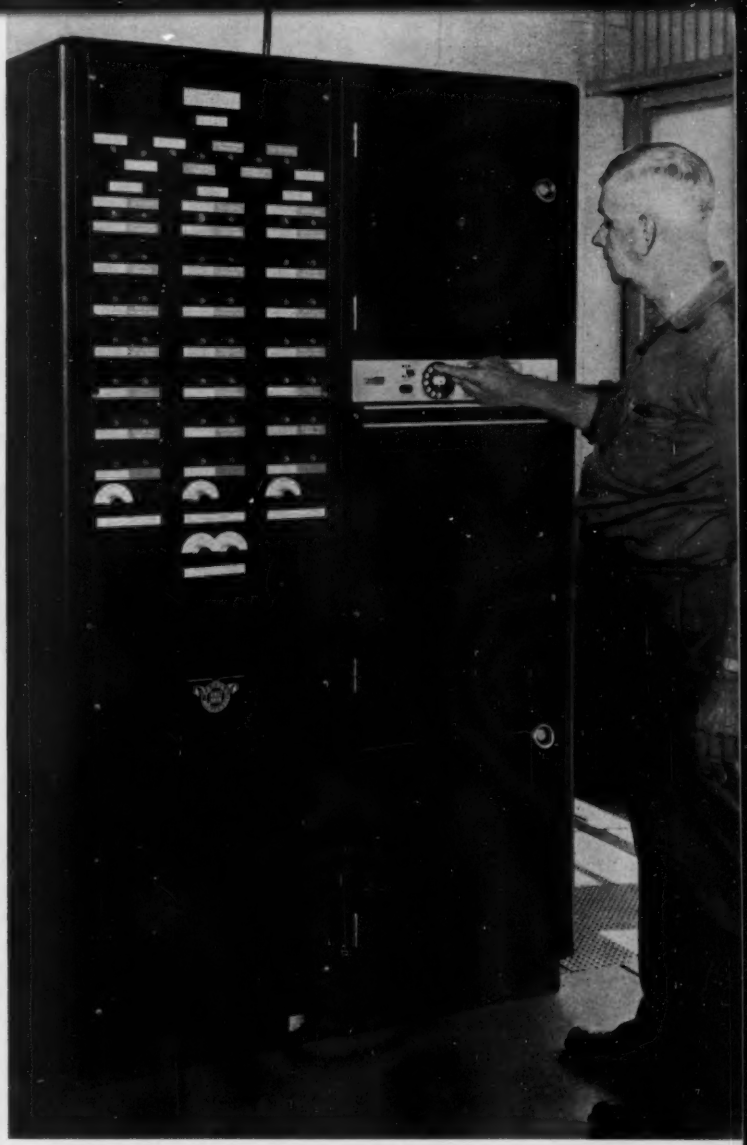
At Crawford Station: En-Tronic Control actuates all functions at McArthur Station and records engine speeds and pressures. Shown here: W. E. Deeds, Engineer in Charge.



At McArthur Station: James Caldwell, Chief Engineer takes a reading from the En-Tronic Control of one of the Cooper-Bessemer compressors. This control actuates starting sequences and monitors the complete operation.

How Cooper-Bessemer equipped McArthur

TO START OR STOP McArthur Station's 1100 hp Cooper-Bessemer compressors, they simply dial a number. This storage field station of Ohio Fuel Gas Company is fully automatic, day and night... controlled from their Crawford Station 34 miles away by Cooper-Bessemer En-Tronic Controls. They start and stop the three GMVA Compressors... record engine rpm, discharge and suction pressures, and gas



At McArthur: This En-Tronic Control is a telemetering and supervisory control unit for the entire operation. Compressors can be started or stopped from this location as well as from Crawford.

Station operates automatically round the clock

flow... and operate the 20″ main valves from the remote station.

Now completing two years of operation, McArthur Station has an impressive record of dependability.

It will pay you to investigate Cooper-Bessemer reciprocating compressors, centrifugal compressors, engines and En-Tronic Controls for *your* expansion and modernization plans. Call our nearest office.

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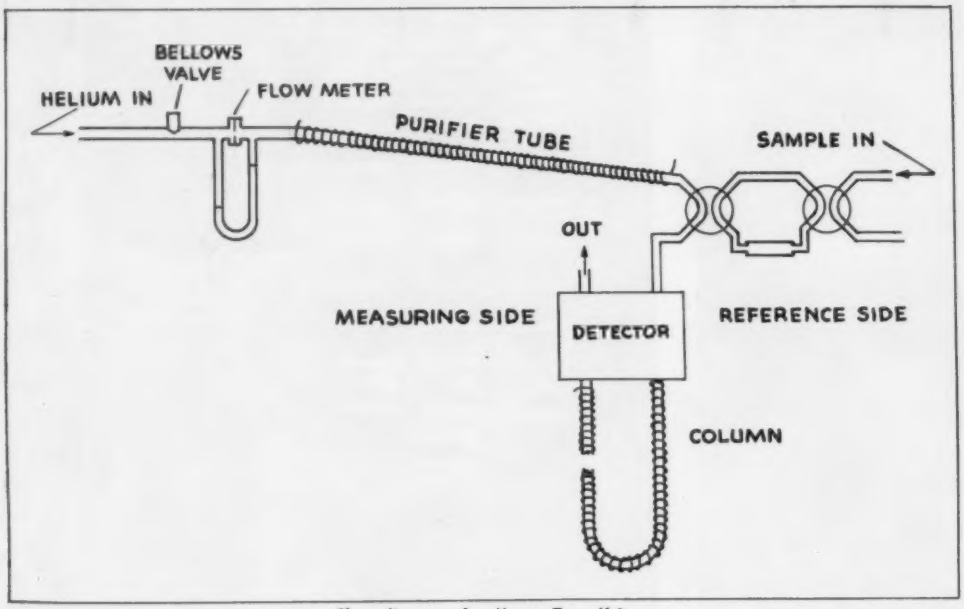


Flow diagram for Kromo-Tog, K-2.

them in varying degrees as they pass through the column.

Take, for instance, a binary mixture. Gas X passes through the column in 10 minutes at a rate of 2 ft a minute. Gas Y passes through the column in five minutes at a rate of 4 ft a minute. The packing material may be set into motion contrary to the flow of gas at a rate of —3 ft per minute. The negative sign represents the direction of flow with reference to the gas. The flow of gas X will be —1 ft per minute; the flow of gas Y will be 1 ft per minute. The two gases are now flowing in opposite directions. They can be removed from the packing at each end of the column by a jet of steam. The packing material will be blown, or carried some way, back to the top of the column for another trip down. Very efficient separation is achieved.[1]

It is possible to separate a mixture of many gases into two parts by choosing a flow rate for the packing material which is between the rates of the gases to be separated. For instance, the flow rate of O_2 through molecular sieves is 3.3 meters per minute, N_2-2.5 meters per minute, and C_1-1.88 meters per minute. C_2, C_3 and so on are progressively slower. If it is desired to remove N_2 and O_2 from the hydrocarbons, the downward flow rate of the packing is set between the flow rates of the two gases nearest the point of separation, C_1 and N_2, about 2.19 meters per minute. N_2 will have a flow rate of .31 meters per minute, O_2-1.11 meters per minute, C_1-.31 meters per minute. The gases with a flow rate greater than 2.19 will pass through the column; those with a flow rate less than 2.19 will be pushed back by the packing and grouped with C_1. Thus two mixtures of gas are now obtained; one containing N_2 and O_2 the other containing hydrocarbons. Further separation is possible by using more columns with different "stationary phase" rates.

To completely separate all the gases in natural gas would take from eight to ten towers. This may or may not be useful or economical depending on the need for such separation and on the volume handled. It is possible that a N_2-O_2, C_1-C_3, C_4^+ separation would be more practical. The N_2O_2 could be vented or sold, the C_1-C_3 fraction sold as fuel gas, the C_4^+ could be sold or used to enrich the fuel gas.

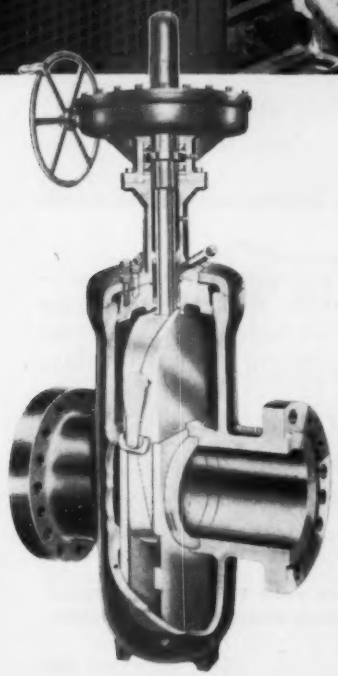
The simplicity of the separation process would make the plant adaptable to automation, using gas chromatography for analysis and control of the gas flow.

• An ionization detector for the Kromo-Tog

Detection of the separated sample is conventionally achieved by a device which measures the change in thermal conductivity of the gas stream passing it. A new detector which measures the flow of electricity through the gas takes advantage of the differing ionization potentials of the gases to be detected.

Ionization of the gas stream is achieved by several means. Energy may be supplied to ionize the gas from a radioactive source, a flame, or a hot wire filament. The detection cell is run at reduced pressure, one to one-tenth millimeter of mercury. Electrons are boiled off the hot wire and ionize the gas in the cell, making it a conducting medium whose resistance depends on the amount of ionization taking place. The amount of ionization is dependent on the ionization potential of the gas stream and is measured by the current flow between a positively charged grid and a negatively charged plate. The carrier gas must have a high enough ionization potential so that it will

1. Desty, D. H., Editor; Vapor Phase Chromatography-1956; New York Academic Press, Inc.; article from a paper presented by M. Freund, P. Benedek, and L. Szepesy of Hungary.



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You exert unique control over the seating in W-K-M Expanding Gate Valves. Fully opening or closing the gate causes it to *expand*. So you can make as tight a seal as you want . . . first Teflon-to-metal, then metal-to-metal.

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A COMPLETELY NEW RUBBER

The BLUE OX SIDE BOOM

Designed and built by FWD as the only integral unit for Pipeline Construction.

A rugged, time and money saving tool, with a lifting capacity of more than 6 tons.

Powered by the big, heavy-duty 150 H.P. BD-308 engine, this rig can lug down to creep speeds of ½ MPH at *full-throttle* or be driven over the road from job to job at speeds up to 47 MPH.

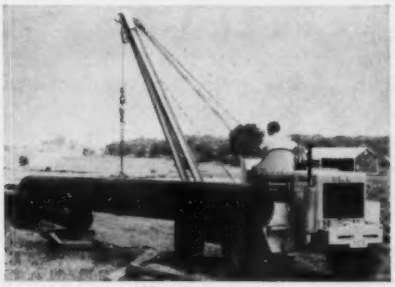
Four-wheel drive, and heavy-duty lug-type tires, give the Blue Ox plenty of traction in sand, mud and off-highway operations.

Four-wheel power steer allows tight turning circles on narrow rights-of-way and busy city streets. No worry either about curb or pavement damage with the rubber-tired Blue Ox.

Low center of gravity, balanced weight distribution, and hydraulic operating controls make the FWD Blue Ox Side Boom the most outstanding new pipe-laying rig in use today.

Low Initial Cost
Low Maintenance Cost
Low Operating Cost
High Production

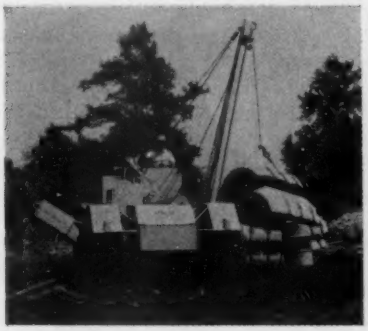
For convincing proof, ask your FWD Dealer for a demonstration or mail handy coupon for full details.



Independent control of rear steer permits the FWD SIDE BOOM to turn in a circle of six feet inside radius.

The FWD SIDE BOOM can be equipped with hydraulically operated angular blade for back-fill and clean-up jobs.

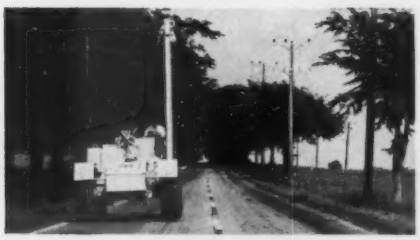
The new FWD SIDE BOOM can unload and string 20 in. gas line pipe with ease. Its mobility and slow creep speed of ½ MPH make it ideal for lining up and spotting pipe.



Handling two 2,500 lb. concrete anchor weights in swamp area presents no problem with the FWD SIDE BOOM. Hydraulically controlled winches simplify lowering and placing.

The FWD SIDE BOOM is at its best in tight, congested areas. Its four-wheel drive and steer, slow creep speed, permit safe operation under city and suburban conditions.

-TIRED PIPE-LAYING RIG



No "lowboy" required with the FWD SIDE BOOM. Its legal width permits it to travel "down the road" at speeds up to 47 MPH.

Blue Ox

*Blue Ox is an FWD TRADEMARK

SPECIFICATIONS

Weight — 18,400 lbs.
Boom Length — 14 ft.
Over-all Width — 96 in.
(with counterweight extended, 129 in.)
Wheelbase — 106 in.
Winches — Two Hydraulic Drive
Steering — Front Axle Hydraulic Power Assist
Rear Axle Full Hydraulic Power
Engine BD-308 — 150 H.P.
Transmission — Speeds — 5 forward, 1 reverse
Tires — 16.00 x 20 - 14 ply
Tread — 76 in.
Ground Clearance — 13 in.
Electrical System — 12 volt

FWD® CORPORATION

FWD Corporation
Clintonville, Wisconsin, U.S.A.
Canadian Factory, Kitchener, Ontario

Send complete data on Blue Ox SIDE BOOM

Name _____

Title _____

Company _____

Street _____

City _____ State _____

G

not be ionized with the sample gas; argon and helium are best. As the constituents of the gas pass through the detector they change the ionization potential of the gas stream and thus the current through the cell.

The ionization detector is much more sensitive than the thermal conductivity detector. Therefore, smaller samples can be used to achieve better separation of the components of the gas sample.

- **Some operating details of the Kromo-Tog**

For analysis of natural gas two columns are required: The two and one half meter Apiezon L column for hydrocarbons and the two and one half meter silica gel column for nitrogen and carbon dioxide.

Operation conditions for the Apiezon L column are: 50 ml. per minute flow rate, detector current 184 milliamps, column heating voltage 25 volts (temperature between 30-40 deg C), a five milliliter sample is used. The sample is entered at a pressure of one-half to 1 lb per square inch. After the sampler tube has been thoroughly flushed a sample is trapped in the tube at atmospheric pressure. The detector cell should be "balanced" at zero before the sample is entered into the helium flow. The attenuation or scale of the recorder is set according to the sample and column. The first peak with the Apiezon L column is a mixture of methane, nitrogen and carbon dioxide and usually represents 90 per cent of the gas. The scale should be X100. The second peak representing ethane which comprises 2 to 10 per cent should be scaled X5 except in very rich samples where the attenuation should be X10. Propane attenuation may be either X2 or X1. Butane and pentanes are nearly always X1. After the seventh peak, normal pentane, the flow of helium is reversed and the polarity of the recorder is changed. The hexanes plus any other heavier alkanes are flushed back out of the column under one peak. The time taken for this flushing is the same time that the flow was in the forward direction. The attenuation on the hexanes plus peak is X1. After this peak has passed the flow is changed to forward, the polarity is changed back and after the base line steadies, the column is ready for another run.

Operating conditions for the silica gel column are 40 ml. per minute helium flow rate, 40 volts column heating voltage (60 to 70 deg C), and 184 milliamps detector current; a five milliliter sample is used. The sample is entered in the same way. The first peak is nitrogen; the attenuation is usually X1 but others are common. Methane is the second peak; attenuation is X20, ethane is the third peak; attenuation is X1. Carbon dioxide is the fourth peak; attenuation is X1. Immediately after the carbon dioxide peak another sample may be entered as there will be time for its carbon dioxide peak, the last one of interest, before the propane peak of the first sample begins. There is no need to reverse the flow if the sample is very dry, but reversing the flow is usually necessary to clean out heavy ends that would interfere with further analyses. Increasing the heating voltage from 40 to 60 volts speeds the flushing process.

Freshly prepared columns or columns which have been out of use may require conditioning before they will give an even base line. Usually this is because they have adsorbed moisture from the air. This water makes a long peak, rendering the column useless until the water is out; sometimes water can impair the ability of the packing to separate the components of a gas. Conditioning is done by heating the column to a high temperature and venting the water-laden helium to the air rather than running it through the detector cell. ■

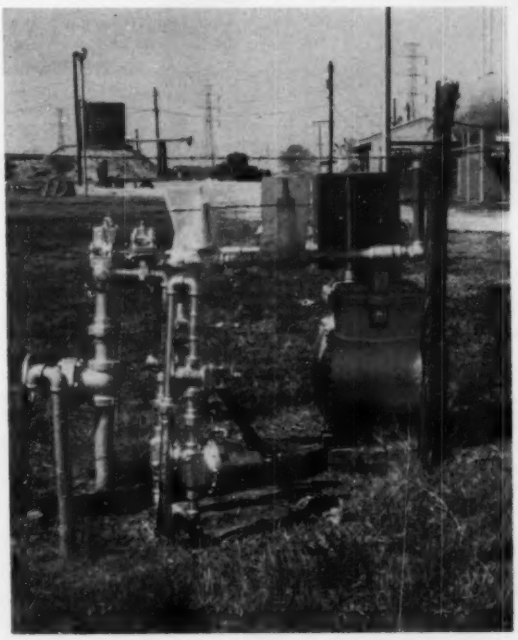
How to protect pressure regulators

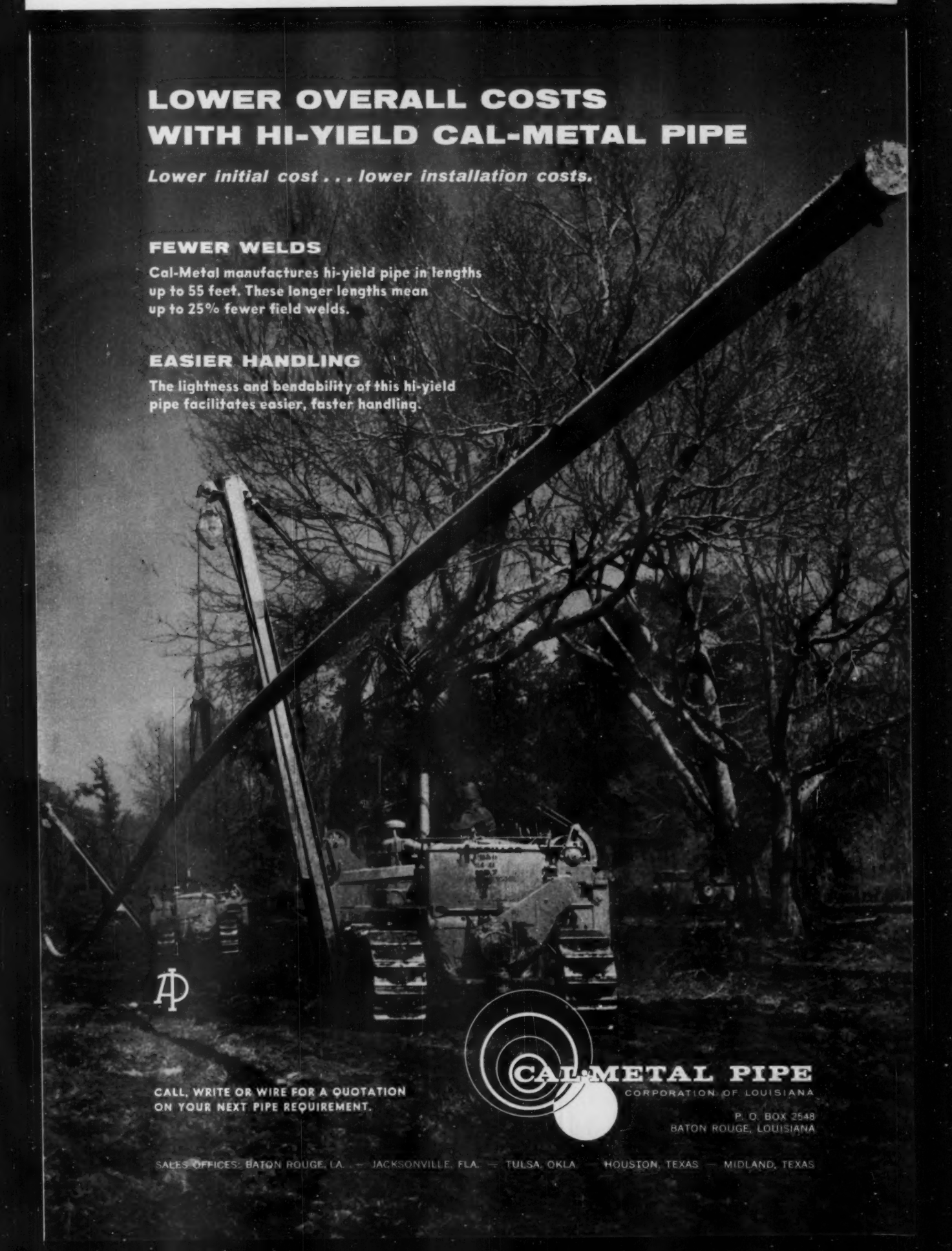
OPERATORS at one pipeline camp gas line have come up with a new way of providing dual protection against mud daubers and blown dirt.

They place plastic bags over each of the regulators (see photo), closing the bags around the flow line with paper clips.

The plastic allows the units to "breathe" with atmospheric pressure changes. At the same time, it effectively guards against plugging of the vents or fouling of the threaded adjusting stems.

If torn, repairs can be made by closing the tear with a paper clip. Also, the cost of replacing such a bag is negligible when compared with loss through malfunctioning of the regulator.

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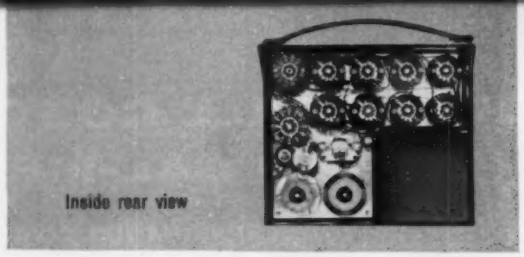
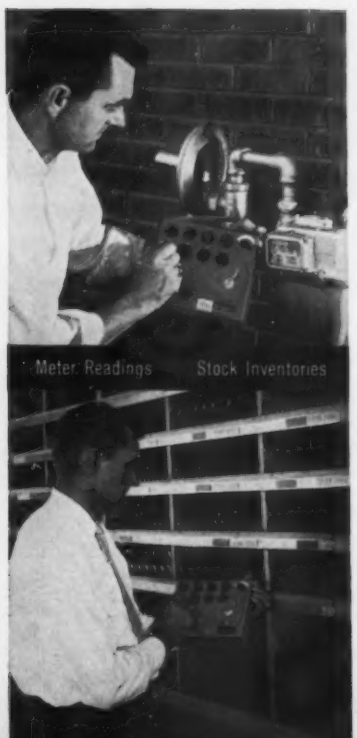

Inside rear view

The METERCORDER is the *first* portable digital tape recorder. It was developed specifically for use in domestic meter reading by utility companies. During the United Gas Corporation's testing period, the Metercorder proved its adaptability for all types of data gathering in retailing and industry. Numbers set into the dials are recorded on ¼-inch magnetic tape by a single stroke of the recording lever. A Metercorder model adapted for your needs records the data you want in one fast, completely automatic operation.



UGC METERCORDER IS . . . . . .

* Sturdily built
* Weighs just 2½ pounds
* Contains no vacuum tubes, oscillator circuits or transistors
* Powered by one 1½ volt penlight battery
* Completely waterproof and weatherproof
* Easy to operate . . . even by gloved hands

UGC Instruments INTERPRETER (pictured at right) translates the recorded information to the computer language used: directly to the computer, to punched paper tape or to punched cards.

Interpreter

UGC INSTRUMENTS
A DIVISION OF UNITED GAS CORP.
METERCORDER

For further information phone or write:
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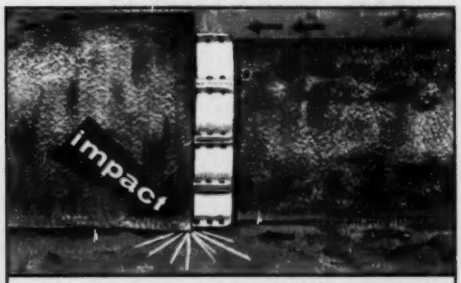
P. O. Box 1407
Shreveport, Louisiana
Phone UN 1-4531 — LD 81

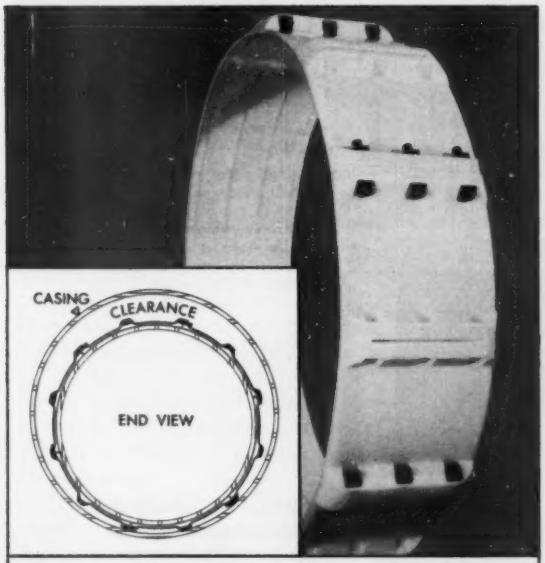
NEWS FROM DOWN THE LINE!

WmSON BIG-INCH M-2 THINSULATORS® MEET RUGGED TEST IN NEW JERSEY TURNPIKE CROSSING

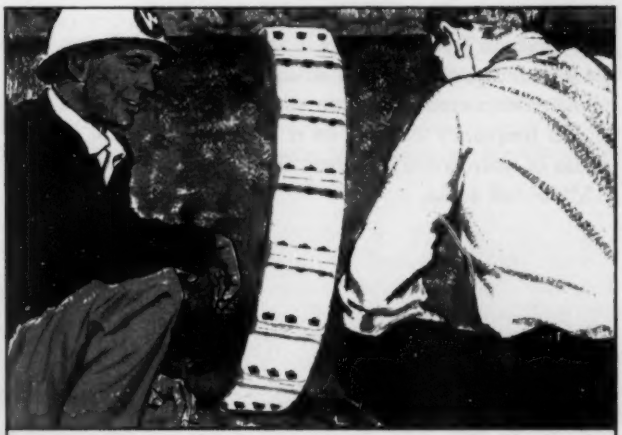
❶ "We'll pull the 36" drag section through this 275' casing. The casing has a slight dog-leg in the center which will make the pull a really tough test of the THINsulators."



❷ "M-2 THINsulators are high-density polyethylene products, resistant to fracture under tremendous impact. Most other plastic insulators are fiberglas reinforced polyesters that don't have the impact resistance, so breakage rates are high."



❸ "The high density polyethylene gives the M-2 such strength it can be made more compact than other insulators, allowing more clearance. It's flexible, so it conforms to the pipe for uniform coating loading . . . and the low coefficient of friction makes it slide like it's greased."



❹ "The tremendous force of the pull caused the lead THINsulator to absorb most of the shock. It twisted slightly but remained intact. All hands agree this is the best plastic casing insulation they have used."

❺ "Consider the economy of M-2 THINsulators. **They cost** no more than other plastic insulators, and breakage is **practically unknown.** Bend 'em, beat 'em, you can't break 'em."

T.D. Williamson, Inc.

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REPRESENTATIVES AROUND THE WORLD

Write Dept. C for Technical Bulletin on the M-2 THINsulator

TELETAX* TELEMETERING

by Foxboro...

engineered for the most advanced transmission techniques

Telemetering matched in performance with famous Foxboro instruments — that's the Foxboro Teletax Telemetering System.

Through use of impulse-duration signals, Teletax electrically transmits measurements of a remotely-located variable to the central control station. Here, the Teletax receiver records the duration of impulse, which is directly proportional to the measured variable.

The Foxboro Teletax System is noted for its simplicity, its versatility, and its high sustained accuracy. For a transmission medium, it can use either AC or DC, an audio frequency carried on a transmission line, or radio or microwave impulses. Sustained accuracy is 0.5% of full scale.

TELETAX RECEIVERS

Teletax receivers include: Single or Dual Receivers; Multi-Record Receivers for recording up to 6 separate measurements on one chart; and Teletax Receiver-Controllers for automatic operation. And the Teletax signal can be simply converted to digital information.

TRANSMISSION LINK

With Foxboro's Teletax Telemetering System, you can use the most advanced transmitting techniques: two wire lines, power lines, radio or microwave. As many as 25 different signals can be handled in each direction, simultaneously.

TELETAX TRANSMITTER

The Teletax Transmitter houses either one or two standard Foxboro measuring elements — plus the Teletax transmitting mechanism. It will transmit to a control center hundreds of miles away just as easily as to one nearby. It also indicates or records locally if desired.

The Teletax Transmitter needs no periodic maintenance whatever, while the receiver requires only occasional oiling. And the receiver has a minimum of mechanical components to wear — no clutch to slip or jam.

Foxboro Teletax Systems are now in wide use on natural gas systems, water works, oil fields, power plants, steel mills, etc. Write for Bulletin 17-11C — it gives all the details. The Foxboro Company, 349 Norfolk Street, Foxboro, Mass.

FOXBORO

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TELETAX TELEMETERING

Communications and Automation

Edited by FRANK CHAPMAN

Texas Eastern's Carpenter looks at the future of pipeline automation

AS taken from *Texas Eastern News*, which reprinted an article from *Financial Analysts Journal*, here is how Texas Eastern's president, Orville S. Carpenter, feels about the future of automation in pipeline operations:

"Prospects for technological improvements in pipelining are almost limitless. The young industry is not circumscribed by a consciousness of having attained the ultimate. Unsurpassable accomplishments have consistently been surpassed.

"Although certain applications are now in service, one major prospect remains—the full development and widespread application of the completely automated pipeline. Liquid pipelines, pumping a practically non-compressible fluid, have already installed stations which are controlled—that is, put on or taken off the line, speeded up or slowed down—solely by the hydraulic conditions obtained within the liquid as it reaches the station site.

"The natural gas pipelines, working with a highly compressible medium, also are making swift progress toward the fully automated system. Already there are in operation installations which are controlled as 'satellite' stations by other manned stations either up or down the line. These stations are not limited to one type of prime mover—or compressor. In one instance, a series of satellite stations is controlled from a central dispatch point.

"The natural gas pipelines recognize that automation, insofar as their problems are concerned, is in its infancy; but past history of that industry makes it certain that there will evolve—along with improvements in pipe and continuing strides in compression equipment—the design changes necessary to attain the goal of full automation."

* * *

• *Collins Radio Co.* has called our attention to its new microwave equipment operating in the 11,000-15,000 mc range. The new MW-601 system is specifically designed to provide terminal circuits for lower frequency systems entering congested areas and to open new frequencies for present licensees and those with no microwave radio systems.

A temperature control chamber for the klystron is one innovation. Electric power is not used for regulation of temperature. A spring-operated mechanical device does the job, using the klystron as a heat source.

* * *

• *A "laser"* (from Light Amplification by Stimulated Emission of Radiation) has been developed by Hughes Aircraft Co., Culver City, Calif. While the radio spectrum is in the range of electromagnetic frequencies from 1 million cps extending to the region of 50 million cps, the laser hops the gap from 50 million cps to 500,000 *billion* cps.

Possible applications for the device include space communications and vast increases in the number of available communication channels.

Hughes' Dr. Theodore H. Maiman describes the laser operation as follows:

(1) A light source, such as a powerful flash tube lamp, irradiates a synthetic ruby crystal. (2) The optical energy excites the atoms to a higher energy state from which the energy is reradiated in a narrow band of frequencies. (3) The excited atoms are coupled to an atomic resonator and stimulated to emit the radiation together; hence, the acronym laser.

This thing can be described as an "atomic radio-light." Its coherent properties are similar to radio waves. Atomic methods are used to generate light beams "brighter than those of the sun or stars, even at their hottest centers."

For use in TV and voice communications, the needle-sharp light beam provides a secure private line free from static. A laser beam could be sent from Los Angeles to San Francisco without spreading more than 100 ft. A conventional searchlight beam would spread about 50 miles over the same distance.

* * *

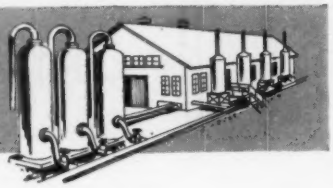
• While Dr. Maiman was telling us about "coherent light," various communications groups were telling FCC about their points of view in the reopened microwave proceeding. The question at hand is: Can there be co-channel sharing between satellite and terrestrial microwave systems without destructive interference? Testifying parties have either joined the "pros" or the "cons."

American Telephone & Telegraph Co. submits a non-sharing thesis. Their Bell Telephone Labs are working up a worldwide communication system which will bounce frequencies between 1000 and 10,000 mc off of space satellites, and say that co-channel sharing will louse it up (as well as terrestrial systems) through direct interference. They want at least 2000 mc space for common carrier satellite communications.

EIA witnesses took the other view. They said the only way the amount of spectrum requested by

Continued on page 135

GAS PIPELINE NEWS



California approves Canadian imports

IMPORTATION of more than 500 MMcfd of Canadian natural gas to the Pacific Northwest area and California was approved by Federal Power Commission. And in mid-August, California's PUC gave its blessing to one of the projects.

Alberta natural gas—some 213.3 billion cu ft annually—will be taken from "enormous" reserves in that province. It will move to the Alberta-British Columbia border by Alberta Gas Trunkline Co. There, it will be picked up by Alberta Natural Gas Co. and moved through B.C. to Pacific Gas Transmission Co., which will pick up the gas at the U. S. border.

Alberta & Southern will make the original purchases from Canadian producers and sell the gas at the U. S. border to Pacific Gas Transmission. Alberta & Southern is wholly owned by PG&E and will own 50 per cent of Pacific Gas Transmission's stock. PG&E will own the rest of Pacific Gas Transmission outright.

This plan involves 418 MMcfd which will be delivered to Pacific Gas & Electric via a proposed 614-mile, 36-in., $133-million pipeline from the U. S. border to the California-Oregon border.

To get this volume from the California state line to San Francisco requires another new pipeline to be built and owned by PG&E. The California PUC authorized PG&E to build this link as GAS went to press.

Following PUC okay, PG&E president Norman R. Sutherland called for construction bids and set ground breaking for early fall. Gas deliveries are slated for the winter of 1961-62.

El Paso Natural was authorized to import more Canadian gas. El Paso can take a new 136.5 MMcfd. El Paso's Northwest Division (the old Pacific Northwest Pipeline) will handle the new Canadian gas in addition to that it now takes. Westcoast Transmission Co. Ltd. will purchase Alberta gas from producers and bring it to the U.S. border via the Alberta Trunk Line and Alberta Natural system as previously described.

Delivery will be made to Pacific Gas Transmission which will transport El Paso's gas 105 miles to a connection with El Paso's Northwest division, which will install some 17 miles of line to bring the new Canadian gas into the vast El Paso system in the Spokane area. El Paso will spend $2.44 million for facilities.

Any part of the gas not needed in the Pacific Northwest markets may be sold elsewhere by El Paso. This provision applies until El Paso shows that this supply will not be needed to preserve the Pacific Northwest's priority of service provided in the Pacific Northwest Pipeline Co.-El Paso Natural Gas Co. pre-merger contract.

The new Canadian supply to El Paso is headed for the California market. However, this gas will not physically reach California, but will replace in the Northwest area a like volume that will be delivered by Colorado Interstate Gas Co. into El Paso's proposed Rock Springs project. (See Rock Springs story on page 124.)

Montana Power Co. also gets Canadian gas under the recent FPC order. Its average delivery will be 30 MMcfd, with an annual delivery of 10.9 billion cu ft.

Montana Power's gas will be purchased in Alberta fields by Alberta & Southern. Alberta Trunkline will transport the gas to a point north of the U.S. border for delivery to Canadian-Montana Pipe Line Co., a Montana Power subsidiary. Canadian-Montana will complete the haul to the U.S. border and sell to Montana Power for its general system at a point near Cut Bank.

The entire international project, including the facilities to be built in California, has been estimated to cost more than $400 million.

Transco has gas, can go

Federal Power Commission Presiding Examiner Robert W. Weston decided Transcontinental Gas Pipe Line Co. has the necessary reserves in hand to support its proposed $52 million-plus expansion program.

Transco wants to build about 280 miles of loops—mostly 36-in. partial third-line loops in the southern half of its vast system—and add 32,040 hp to 12 compressor stations.

Transco estimates it will need more than 10.1 trillion cu ft of gas to supply system requirements for the 20-year period starting Jan. 1, 1961. On the same date, system reserves will total about 8.1 trillion. And Transco said new reserves in the order of 718 billion cu ft acquired prior to Jan. 1, 1960 exceed the requirements to be handled by the expansion program.

The examiner found Transco's supply adequate for a 12-year supply, which recent FPC authorizations tend to center on.

Mich-Wisc can add 100 million

Michigan Wisconsin Pipe Line Co. has FPC authorization to construct 567 miles of pipeline and add on 6000 additional compressor hp to increase its average daily sales capacity by approximately 100 MMcf. The project will cost almost $45 million.

With these new facilities in place, Michigan Wisconsin will be able to meet peak day requirements of 1.39 MMcfd, including gas taken from storage. The company had previously been authorized to enlarge its system to take 80 MMcf from the Laverne field.

Additional gas will be supplied to: North Central Public Service Co., St. Paul, Minn.; Michigan Gas Utilities Co., Coldwater, Mich.; Wisconsin Southern Gas Co., Lake Geneva, Wis.; American Gas Co., Omaha; Wapello Light Co., Des Moines, Iowa; and Stanberry, Mo.

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Woodall approves Rock Springs project

Just before he retired from the FPC, examiner Emery J. Woodall approved the Rock Springs project of El Paso Natural Gas Co. and Colorado Interstate Gas Co. (Dockets G-16235 et al). A few days later, the commission approved Transwestern Pipeline Co.'s plan to increase its just-started deliveries to the southern California market. Thus, within the space of a week or two, that huge gas-consuming, never-satisfied area was promised more gas—from Canada, the Rocky Mountains, Texas, and Oklahoma.

Woodall overruled objections of oil companies who contended that the gas could not be be sold in the estimated quantities because of competition from oil. This competition, they claimed, made the project of questionable feasibility.

Woodall replied that the intervenors aren't worried that the gas can't be sold. Their objections are prompted by a "lively fear that it will be sold in such volumes on an interruptible basis and thus prevent the development of an industrial fuel scarcity, which would benefit the oil companies through resulting price increases, and which the blocking of the Rock Springs project would cause."

The new pipeline network extends from Rock Springs, Wyo., to the California-Nevada border and supplies 470 MMcfd to the southern California market area.

CIG would build a 155-mile, 34-in. line from Rock Springs to Provo, near Salt Lake City. There, it would connect with a 394-mile, 34-in. line to be built by El Paso to near Las Vegas, Nev. The gas would be delivered at the point into a 92-mile, 34-incher proposed by Southern California and Southern Counties Gas companies. El Paso's Provo-Las Vegas line includes a 7200-hp compressor station.

CIG's new line connects with the western terminus of its existing system at Green River, Wyo., where a connection is to be made with the Canadian gas supply of El Paso's Northwest division. (Since El Paso's acquisition of Pacific Northwest Pipeline Co., its system extends west from Texas to the California border and north to the Canadian border in Washington.)

Of the 470 MMcf to be delivered to Cal-Counties, about half will be sold to El Paso by Colorado at Rock Springs. The other half will be delivered by El Paso to Colorado at Rock Springs. Thus, Colorado will transport the entire 470 MMcf from Rock Springs to Provo.

Initial price of the gas to the Californians will be 40 cents per thousand.

El Paso expects to spend $58.6 million on its portion of the project.

Colorado Interstate's share will cost it $92.8 million.

Other facilities to be built by Colorado Interstate practically constitute an entirely new system. These include 109 miles of 26-in. from Fourway, Texas to Morton county junction in Colorado; 136 miles of 34-in. from Junction to Pueblo; 106.8 miles of 30-in. from Pueblo to Denver, and 83,880 hp in compression.

CIG will retire 244.3 miles of old 20- and 26-in. from near Amarillo to Denver and 27,115 hp in compression.

Completing the major overhaul, Interstate will reverse the flow of its Denver-Green River 22-in. line.

Colorado Interstate's system deliveries to its Rocky Mountain service area will be enlarged from 630 MMcfd to 710 million.

Arkansas gas goes for in-state use

Arkansas Louisiana Gas Co. has entered a long-term agreement with Gulf Oil Corp. to buy all gas produced in the rapidly developing Arkansas valley area of western Arkansas.

Present and potential gas production from the area will remain in the state, dedicated to use by Arkansas industries and homes.

ALG board chairman and president, W. R. Stephens, said the agreement enables Gulf to immediately undertake extensive drilling and developing of its Arkansas valley acreage. ". . . Gulf has been able to negotiate a contract price for its gas at the wellhead which will make development of this acreage profitable."

The 20-year contract contains a specific intrastate clause providing that all natural gas produced from wells and acreage covered by the contract must remain in Arkansas.

The contract covers presently developed reserves in the Knoxville field of Johnson and Pope counties, the Spadra and Paris fields of Logan county, the Washburn field of Sebastian county, and a portion of the Kibler field in Crawford county. In excess of 300,000 acres of developed or undeveloped acreage in the upper Arkansas River valley is under lease to Gulf.

Texas Gas' 4-state plan gets go-ahead

FPC approved Texas Gas Transmission Corp.'s four-state, $7.9 million construction program covered in Docket CP60-55.

Texas Gas will build 23.7 miles of 30-in. loops on its main supply line between Eunice and Bastrop, La.; 56 miles of 12¾-in. pipe in Indiana; and 6700 additional compressor hp in three stations in Tennessee, Kentucky, and Louisiana.

The Louisiana loops let Texas Gas take an additional 70 MMcfd from producers in south Louisiana. The Indiana construction provides considerable flexibility to the northern portion of the company's system.

Gathering system wanted in Calgary

Jefferson Lake Petrochemicals of Canada Ltd. wants to build a gas gathering system and processing plant to serve the Calgary gas field. The processing plant would handle 150 MMcf of raw gas daily. Output per day would be 107.4 MMcf of residual gas, 2170 bbl of condensate, and 863 long tons of sulfur.

Westcoast Transmission Co. Ltd. has contracted to buy the processed gas for export to the U. S.

C-B division builds

Cooper - Bessemer Corp.'s En-Tronic Controls division will be housed in a new building now under construction. En-Tronic was formed in January of this year to handle complete systems engineered for precise control of engine and compressor units.

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	.219"	10.00
	.237"	10.79
6⅝	.156"	10.78
	.188"	12.89
	.219"	14.97
	.250"	17.02
	.280"	18.97

Steel

Pioneer 6.52% return gained by Southern

A pioneer rate return of 6.52 per cent on pipeline and production facilities has been allowed Southern Natural Gas Co., Birmingham (Docket G-20509).

The new rate is partially based on a 6.5 per cent rate of return on pipeline properties, which the FPC says is fair, just and reasonable. It is also partially based on a 7 per cent return on the company's production facilities. Southern Natural produces about 8 per cent of its gas requirements.

The commission action was an interim step in a case involving a proposed $7.7 million annual wholesale gas rate increase.

Largest storage field made ready

An underground natural gas storage field with the largest total reservoir capacity in the nation will go on-stream in November. Pacific Gas & Electric is turning the nearly depleted McDonald Island natural gas field in the San Joaquin River delta of central California into a gas storage reservoir.

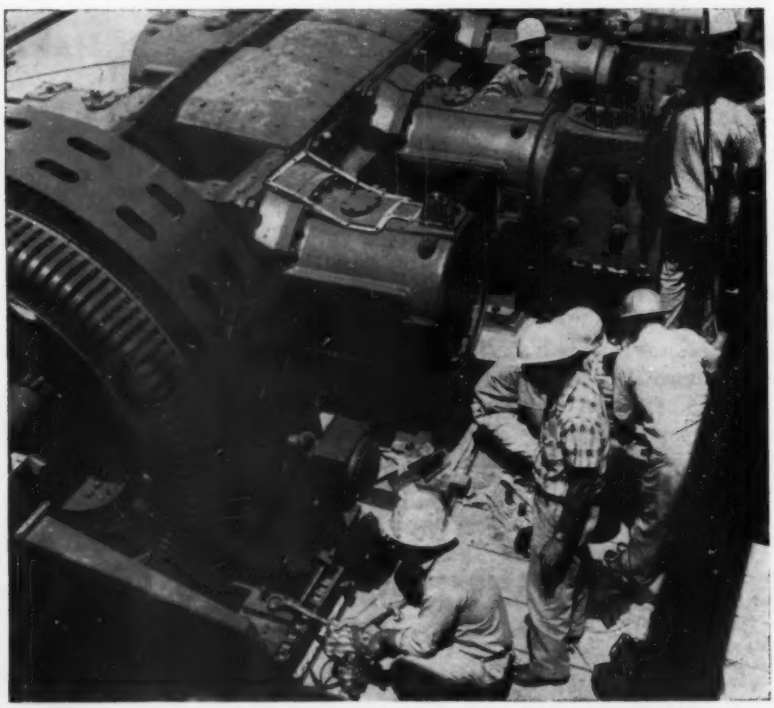
When completed late in 1961, the field will have a working storage capacity of 30 billion cu ft of gas and a daily deliverability of 400 MMcf. A cushion of 54 billion cu ft will remain in the field.

Initially, in November deliveries will be about 75 MMcfd—enough to serve the average winter needs of some 170,000 homes.

Nearing completion at McDonald island is a building to house a 2000-hp, electric-driven compressor, gas dehydrators and scrubbers, and a 60,000-v electric substation to power the compressor. The house sits atop a concrete platform built about 17 ft aboveground to avoid flooding should the levees that border the island fail. The platform is supported by 137 piles sunk 60 ft into the sandy soil.

A second compressor at Brentwood terminal station—some 17 miles away from McDonald—pushes the gas through an 18-in. line to the island.

McDonald is the second storage field developed by PG&E. The first, at Pleasant Creek in Yolo county, was completed last year. It has a working storage capacity of 3.25 billion cu ft.



PG&E technicians install 2000-hp compressor at McDonald Island gas storage field. Compressor will be used to inject gas under pressure into the field, soon to be the nation's largest.

Inter-related plan approved

Six applications by four pipeline companies to benefit customers in the Midwest and East, including New England, were approved by an FPC presiding examiner (Dockets G-18968 et al).

The decision relates generally to Texas Eastern Transmission Corp.'s plan to expand its system to a maximum of 334 MMcfd to benefit 23 of its wholesale customers.

Other companies involved are Algonquin Gas Transmission Co., Transcontinental Gas Pipe Line Corp., and New York State Natural Gas Corp.

About $40.6 million will be spent by TET on 214 miles of 20- to 36-in. line and a new 3300-hp station in Pennsylvania, New Jersey, and New York. Also, it will jointly develop, with Transco and New York Natural, its share of the Leidy storage field in Pennsylvania. The $8 million program will be shared with Transco.

Algonquin can spend $5.5 million in Massachusetts to transport and sell 75.1 MMcf of winter service gas it will receive from Texas Eastern. Involved are 30 miles of pipeline and 8000-hp compressor capacity.

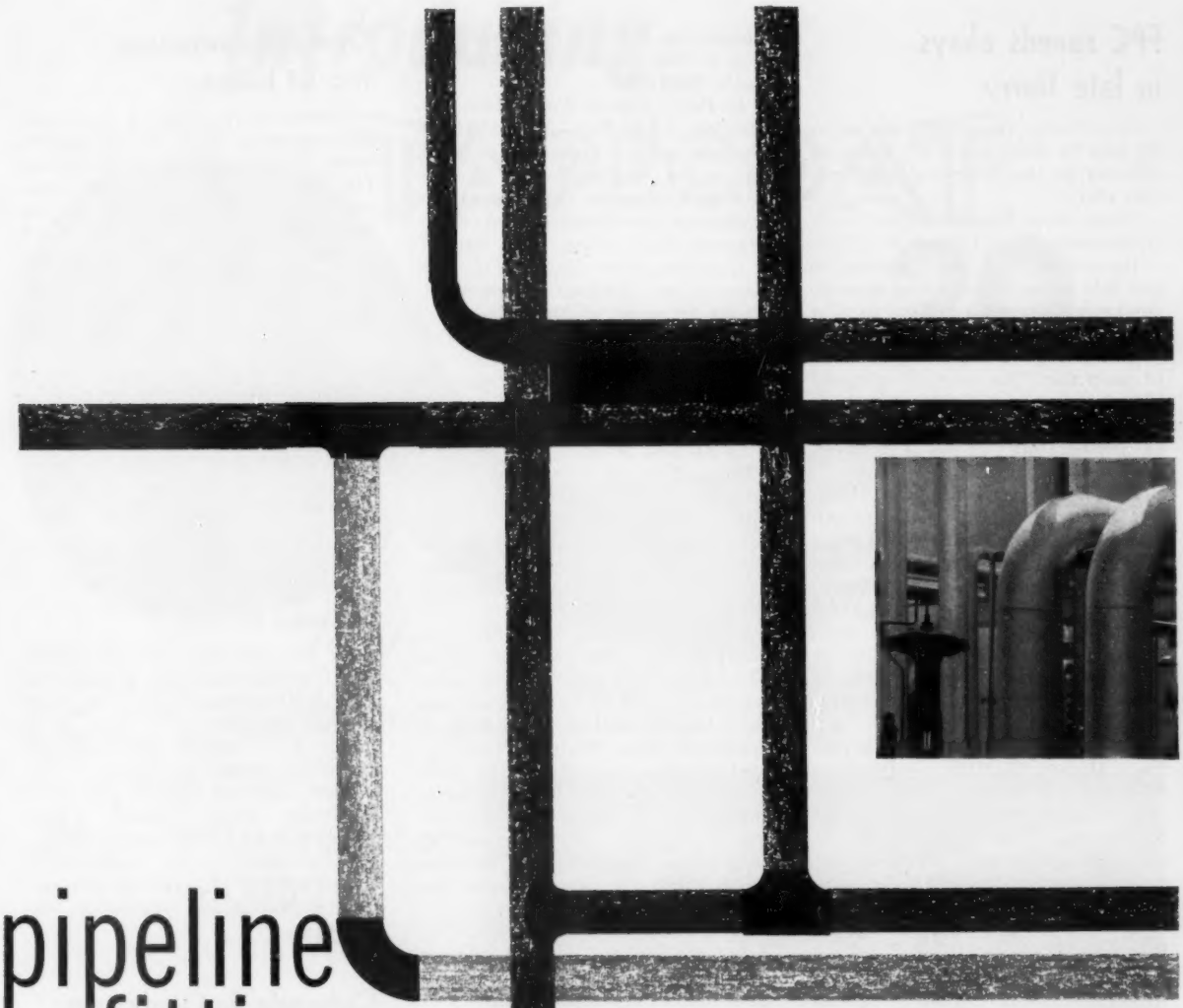
Transco will build a 6000-hp compressor station costing about $2.9 million in Pennsylvania to fulfill its delivery obligations in the Leidy storage area. TET and Transco each own one-quarter interests in the field, New York Natural the balance.

UGPL consolidates district offices

United Gas Pipe Line Co. is consolidating its Dallas district and the Tyler district of Union Producing Co. At the same time, the company named F. B. Winbery as manager of the consolidated district. He formerly managed the Dallas pipeline district.

The move results in closer coordination of the activities of the two districts, which operate in almost identical areas. Main offices of the district will be in Tyler. The district's dispatching department moves to the UGPL office in Carthage, and the chart department transfers to United Gas general offices in Shreveport.

When the consolidation is completed, the district pipeline office in Dallas will be closed.



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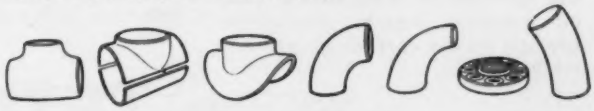

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FPC speeds okays in late flurry

In a flurry of last-minute activity late in July, the FPC gave its blessing to the following construction plans:

Texas Gas Transmission Corp., Owensboro, Ky. (Docket G-19510)—Development of West Greenville gas field as an underground storage reservoir. The $2.5 million project consists of 29.5 miles of 12-in. line from the field (Muhlenberg county) to main facilities near Slaughters; 1760-hp compressor station, and appurtenant facilities. Ultimate peak-day deliverability of the field: about 85 MMcf.

Transwestern Pipeline Co., Houston Docket (G-20464 et al)—An $8.7 million plan covering 250 miles of gathering lines and three new compressor stations totaling 8040 hp. New gas supplies coming from producers were conditioned with initial prices ranging from 16 to 18 cents per Mcf instead of the 18 to 23 cents proposed by the producers.

Pennsylvania Gas Co., Warren, Pa. (Docket G-20121)—Development of an underground storage field in Erie county. Work on the $1.1 million project includes reconditioning 46 wells, plugging 10 wells, and installing a 440-hp compressor unit.

Texas Gas Transmission Corp., Owensboro (Docket CP60-75 et al)—A 17-mile, 10¾-in. line from the eastern end of its 20-in. line near Thibodaux, La., to a new meter station in the Bayou Chevreuil field. Cost: $965,200.

El Paso (Texas) Natural Gas Co. (Docket CP60-58)—An additional 6800 hp at its Goldsmith station and other facilities will provide 58.8 MMcfd more capacity at the Goldsmith purification and dehydration plant. Cost: $3.9 million.

Mountain Fuel Supply Co., Salt Lake City (Docket CP60-89)—About 20 miles of 20-in. loop will increase pipeline capacity from 240.7 MMcfd to 260.4 MMcfd. Included in the $3.1 million plan: a 2640-hp compressor station, and replacement of 16- and 18-in. line with 24- and 20-in.

Hope Natural Gas Co., Clarksburg, W. Va. (Docket CP60-67)—Will replace about 20 miles of 12-in. line with 20-in. pipe at a cost of $2 million. Lines are in Lewis, Ritchie, and Pleasant counties, W. Va.

Kansas-Nebraska Natural Gas Co., Hastings, Neb. (Docket CP60-84)—About 167 miles of line ranging from 2 to 8 in. in diameter, and town border stations for Cahdron, Crawford, Hay Springs, Hemingford, Gordon, and Rushville, Neb. Cost: $1.6 million. New facilities will extend Kansas-Nebraska's system in northwestern Nebraska to enable gas deliveries to Western Gas Fuel Co. for new service in the six Nebraska communities.

Tennessee Gas Transmission Co., Houston (Docket CP60-64)—About 11.6 miles of 12-in. line in offshore Louisiana.

Oil may be brought to surface by radar

Deep-penetration radar beams soon may help unlock trapped oil reserves jellied in rock thousands of feet beneath the earth's surfaces.

Raytheon Co. revealed it has under development an electronic oil well heater which may aid in the recovery of some of the vast oil reserves which cannot be brought to the surface by present methods.

Peoples realignment plans to be heard

Hearings are due in September on Natural Gas Pipeline Co.'s plan to acquire and operate its affiliate, Peoples Gulf Coast Natural Gas Pipeline Co. (Docket CP60-97).

Both companies are subsidiaries of the Peoples Gas Light & Coke Co., which would own all of the outstanding stock of NGPL as the surviving company.

Peoples Gulf was organized last year with the acquisition of the pipeline system of Texas Illinois Natural Gas Pipeline Co. This was the first step in the proposed realignment of the Peoples Gas System.

Gathering system launched

Lone Star Gas Co. is laying gathering lines in the Rising Star area of Eastland and Comanche counties, Texas. The pipeline network will transport gas purchased from Coastal States Producing Co. into Lone Star's Mission system near Gordon.

Operating revenues top $4 billion

Operating revenues of interstate gas companies filing annual reports with FPC totaled over $4 billion for the year 1959. For the same period, sales of natural gas by the same companies amounted to 11.19 trillion cu ft. According to the FPC report, 96 interstate natural gas companies were operating during '59. Their combined assets at year end were close to $11.5 billion.

Sales of natural gas and revenues from such sales reported by natural gas pipeline companies amounted to 9.37 trillion cu ft and $2.9 billion, respectively. These represent increases of 10.1 per cent over 1958 sales and 14.4 percent in revenues.

50 MMcfd expansion planned by TET

On file with FPC is Texas Eastern Transmission Corp.'s plans for a 50 MMcfd expansion in its daily delivery capacity.

The $17.5 million program will benefit 15 present customers.

New facilities include 66 miles of 30-in. loops between Vidor, Texas, and Lambertville, N. J.; 33,710 hp additions in compression equipment at four existing stations, plus metering and regulating facilities.

Colorado line under way

Work is under way on a gas pipeline and distribution system to bring gas to Colorado's western slope. When the 65-mile line is completed, Rocky Mountain Natural Gas Co. will distribute gas in the towns of Delta, Montrose, Cedaredge, Orchard City, Olathe, and Collbran. Cost is estimated at $3 million.

Methane from Sahara planned for Sicily

A group of Italian firms has organized in Palermo the Sicilian Methane Gas Pipeline Co. (SOSIM). Plans call for an underwater gas line to cross the Sicilian channel. It will move about 1.5 million cubic meters of methane per year from the Sahara.

Methane will be brought to the coast of Tunis from the rich deposits lying in the most westerly part of the Algerian Sahara.

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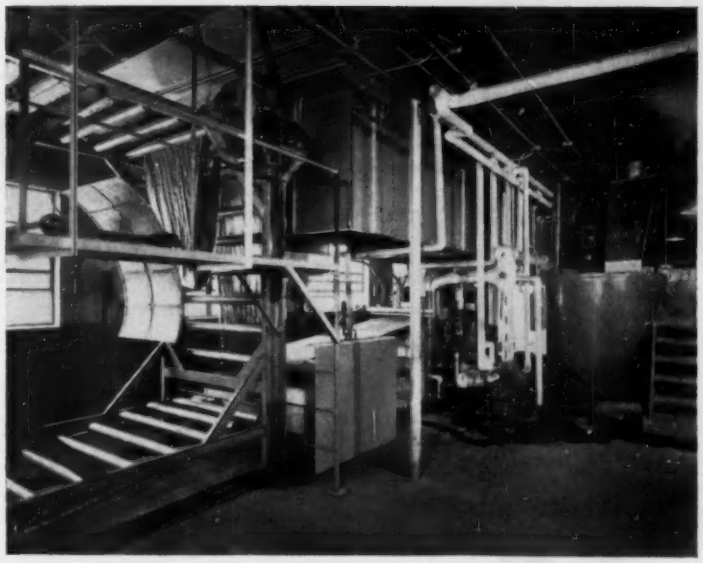

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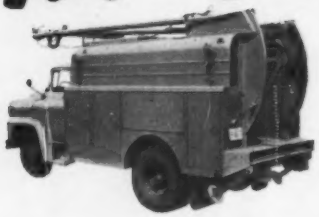

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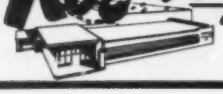

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NGPL, Peoples Gulf projects endorsed

Construction plans of two subsidiaries of Peoples Gas System won FPC approval (Dockets G-19086 et al). Involved are Peoples Gulf Coast Natural Gas Pipeline Co. and Natural Gas Pipeline Co. in the expenditure of $74.6 million.

Peoples Gulf will build about 371 miles of 30-in. line paralleling parts of its existing system, about 56 miles of supply lines, a new 6700-hp compressor station, and purchase meters. Cost: $43.5 million.

NGPL will build 151 miles of 36-in. loops between Compressor Station No. 103 and Joliet, Ill.; 180 miles of 24-in. line between Station No. 103 and No. 156 in Kiowa county, Okla.; and additional metering and regulating facilities. Cost: $31.2 million. Commissioner Kline dissented on the 180-mile portion of the plan.

Peoples Gulf facilities will boost its daily design capacity by 85 MMcf; NGPL's will increase by 100 MMcfd.

Under the authorization, seven independent producers can sell gas to Peoples Gulf from fields in Aransas, Brazoria, Calhoun, and Galveston counties, Texas. Initial price was conditioned at 20 cents per thousand, with an escalation of 3 cents per Mcf after 10 years. Producers had proposed an initial price of 20 cents, with 2-cent escalations every four years until a price of 28 cents was reached.

Bristol acquires Data-Master operation

Bristol Co., Waterbury, Conn., has acquired Hanson-Gorrill-Brian Inc. of Glen Cove, N. Y. The business will be operated through a new subsidiary known as the Data-Master Corp.

Data-Master digital logging systems have often been marketed in conjunction with Bristol automatic controlling, recording, and telemetering instruments.

PanAm buys into pipeline

Pan American Petroleum Corp. has acquired a 50 per cent stock interest in Texas Gas Corp., Houston.

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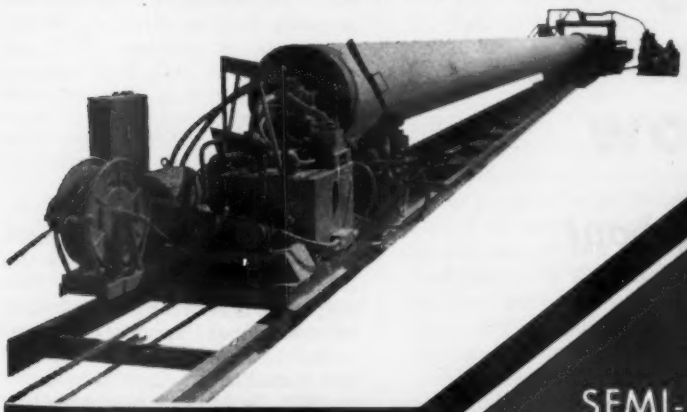

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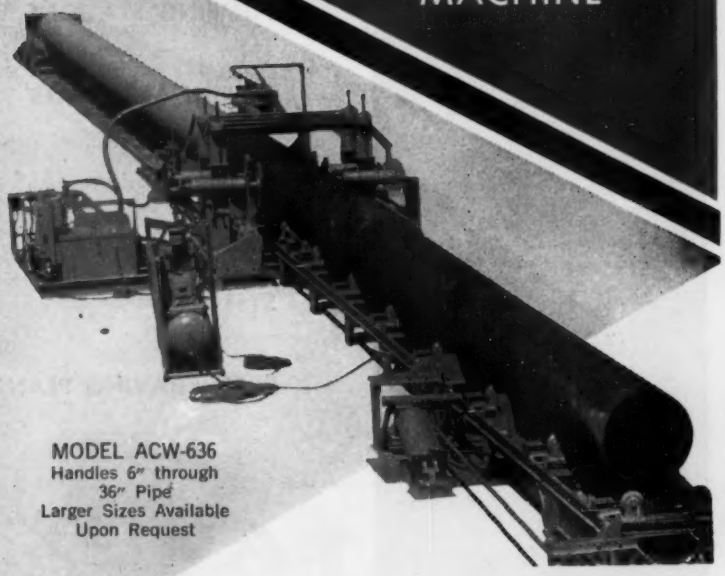

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GAS Pipeline People

ERNEST T. ROBINSON JR. is vice president in charge of gas operations of Texas Eastern Transmission Corp., Houston. The post was formerly held by E. R. CUNNINGHAM, who is retiring. With the company since 1947, Robinson has served as engineer, assistant pipeline superintendent, division manger, assistant general superintendent, and general superintendent of gas operations.

STANLEY E. JOHNSON, vice president and director of sales for Cooper-Bessemer Corp., Mt. Vernon, Ohio, is retiring after 42 years of continuous service. Johnson joined the company in 1918 and was named assistant sales manager in 1932. In 1944 he became acting sales manager and a year later became a vice president and director of sales. He has been a director of Cooper-Bessemer since 1946.

FLOYD E. STANLEY has resigned as president of the Houston Corp. He will continue with the company as chairman of the board.

Several appointments have been announced by Cooper-Bessemer Corp., Mt. Vernon, Ohio. O. W. STANLEY is branch manager of the Odessa, Texas operation. He fills the post vacated by C. L. MCDOUGALL, who has been named assistant parts sales manager in Mt. Vernon. DONALD A. HARNSBERGER has joined the company's international division as technical coordinator. WILLIAM F. HEAVEY has joined Cooper-Bessemer as sales engineer in the Washington office.

HOWARD S. GLEASON has been named vice president, manufacturing, of Southwestern Industrial Electronics Co., one of the Dresser Industries. He formerly was assistant to the president. JOHN C. BLACK JR. has been appointed manager, field service department.

EDWARD L. KRAL, formerly with the Houston office of Daniel Orifice Fitting Co., has transferred to the company's Odessa office where he will assume inside sales duties.

JOE J. KING, senior vice president of Tennessee Gas Transmission Co., Houston, has been named a fellow of the American Society of Mechanical Engineers.

Washington • *Cont'd.*

from page 19

"Support the establishment of a national fuels policy." The Republican platform supports only "long-range minerals and fuels planning and programming, including increased coal research."

Public Power—Democratic platform writers pledged a new expansion program of federal construction of dams, and hydro-electric facilities in "a balanced plan for each major river basin." Republican plank promises only to continue federal-state "partnership" programs and continued observance of the "preference clause" in marketing federal power.

Natural Gas Legislation — Specific reference is not included in either platform. Republicans by inference in general policies supporting free enterprise with minimum government control might indicate support of some "moderate" measure. Statements of some key Nixon supporters say privately a Republican Administration would go "a little farther" in support of a bill than Eisenhower's weak endorsements. Democratic platform drafters through emphasis on increased government regulation of business, a new department of consumers to give voice to city dwellers, and pulling tight rein on "consumer exploitation," indicate a Kennedy Administration would oppose such legislation.

REA co-ops—Both parties, eyeing the farm vote, cast a crumb to the government-subsidized farm power program, even though 97 per cent of all farms are electrified and 75 per cent of new consumers are nonfarm users. Republicans hedged in their support, however, saying only they would continue to encourage "farmer-owned and operated cooperatives." This could leave room for support of higher REA interest rates, or a cutdown in the federal loan program, as has been urged by the Eisenhower Administration.

At this time of the political cycle, businessmen, particularly in utility industries, are given a back seat in the affections of vote-seeking politicians. When the next Administration is in power, things obviously won't be as bad as they might look. A lot of the promises that appear likely to drown business in a sea of socialism are put on a shelf to collect dust. But many are not.

One thing is clear. The trend of the new government, no matter which party wins, is for more, not less, government intervention.

FEDERAL regulatory agencies, including the FPC, aren't likely to get out of the quagmire of criticism into which they were pushed by electioneering politicians without suffering some injuries.

It may be a long time before they can be scrubbed completely clean.

For the one clear result of the congressional probes of the policies and people of these agencies is the glaring need for changes in the laws under which they operate. Reforms are badly needed in the laws setting their powers, duties, methods and extent of regulation, and

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in built-in regulation of the regulators.

First action aimed at the regulatory agencies is likely to be a measure to outlaw all informal attempts to influence decisions. This would be the direct outgrowth of the probes of influence-peddling of the past couple of years.

But it only skirts the fringes of the broad shortcomings of the regulatory agency system—their inability, because of ill-conceived patchworks of laws and long histories of conflicting, unclear and uninformed court decisions, to cope with the intricacies of today's massive industry.

The House Commerce Committee, which was the principal hunter in the regulatory probe, took the first step toward reform as Congress left for its convention recess. The Committee unanimously approved a measure providing stiff fines ($10,000) and a year in jail for anyone convicted of making an off-the-record approach to an agency about issues in a pending case. Members of Congress would also be liable to the penalty.

Except for a simple inquiry about the status of a case, the measure would make it illegal to contact privately members or employees of one of these agencies about a case in formal proceedings.

This would include any attempt to influence a commission's decision "by the use of secret and devious methods calculated to achieve results by the exertion of pressures, by the spreading of false information, by the offering of pecuniary or other inducements, or by other unfair or unethical means."

At about the same time, a special subcommittee of the Senate Judiciary Committee held several days of hearings on various proposals to revise standards of conduct, but took no action.

A politically inspired game of hide-and-seek Democrat lawmakers played with the Eisenhower appointees to the FPC in the closing days of the session also points to the serious problem of competent manpower for these agencies.

The lawmakers refused to confirm two Eisenhower appointees to fill two vacancies on the FPC. One of the two, Paul A. Sweeney, a career government employee, accepted a recess appointment. The other, younger Thomas J. Donegan, refused to accept a similar appointment. Although both are registered Democrats, as required by law, congressional leaders obviously hoped that the terms would remain unfilled until next year when they had a fighting chance to fill them.

To ice the cake, Congress approved a measure allowing members of the commissions whose terms expire to continue in office until their successors are appointed and confirmed in the Senate. Former FPC Commissioner William Connole, fired by President Eisenhower, refused to accept the "lame duck" tenure the new law would have given him.

Streamlining, modernizing, reforming the various laws under which these regulatory agencies operate, such as the Natural Gas Act, will be a much harder, delicate, and complicated job. Proposals range all the way from abolishing

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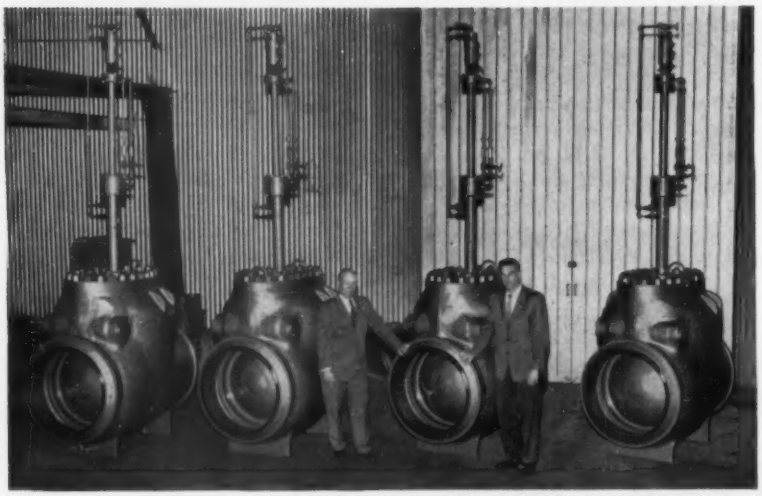

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the agencies and splitting their administrative, regulatory, and appellate functions among other existing branches of government, to measures such as the Harris natural gas bill.

This will take some time. But it is becoming apparent that the wheels which will eventually reorganize the regulatory agency system are beginning to move. Which way they'll turn will take time to tell.

communications • *Cont'd.*

from page 121

common carriers can be obtained is through sharing. EIA claimed that by use of a stationary satellite more than four continents of the earth can be served by the one fixed stationary satellite.

Both AT&T and EIA people agreed that "laser" (see above) will not be effective for space communications.

Other witnesses joined one camp or the other in the matter of sharing spectrum and the adequacy of spectrum space for earth and satellite communications systems.

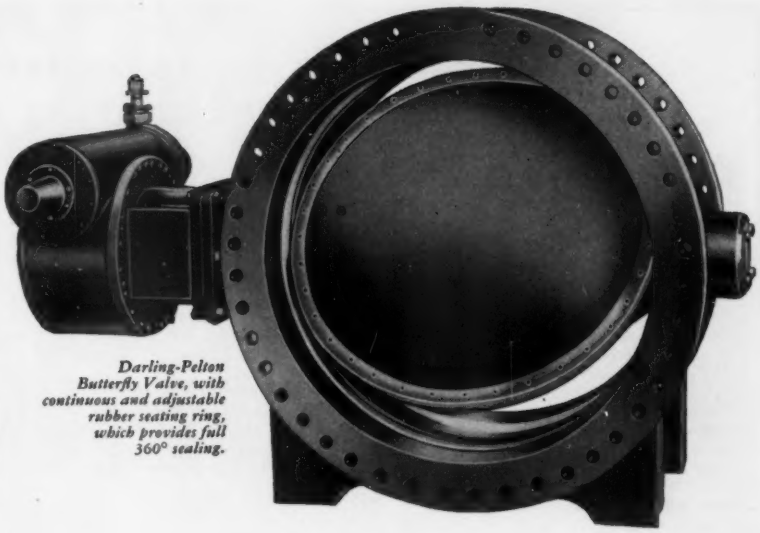
* * *

• *IBM has announced* development of its 1001 data transmission system. Used with telephone company service, such as Bell System's Data-Phone, IBM-1001 transmits both fixed data from prepunched cards and variable information keyed in manually.

A receiving station accepts the data, punching it into cards which are then ready for processing. It is designed for any size organization with one or more locations, whether these be many points across the country or just a few within a single city or building.

The 1001 will transmit data from a card at about 12 card columns per second. A maximum of 22 consecutive columns of numerical data can be read from each card. Manual data can be punched into each card. An average of eight to 12 card transactions per minute can be handled.

Thus: "Business information can now be transmitted in machine-readable form for little more than the cost of a regular telephone call." ■



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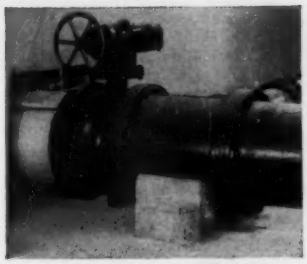
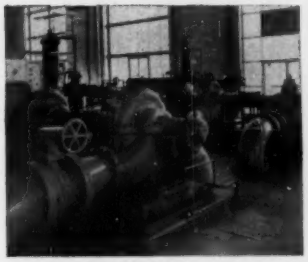


Close-up view of installation in large municipal water plant.



View of Darling-Pelton Butterfly Valves installed in Pittsburgh's new filtration plant.

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